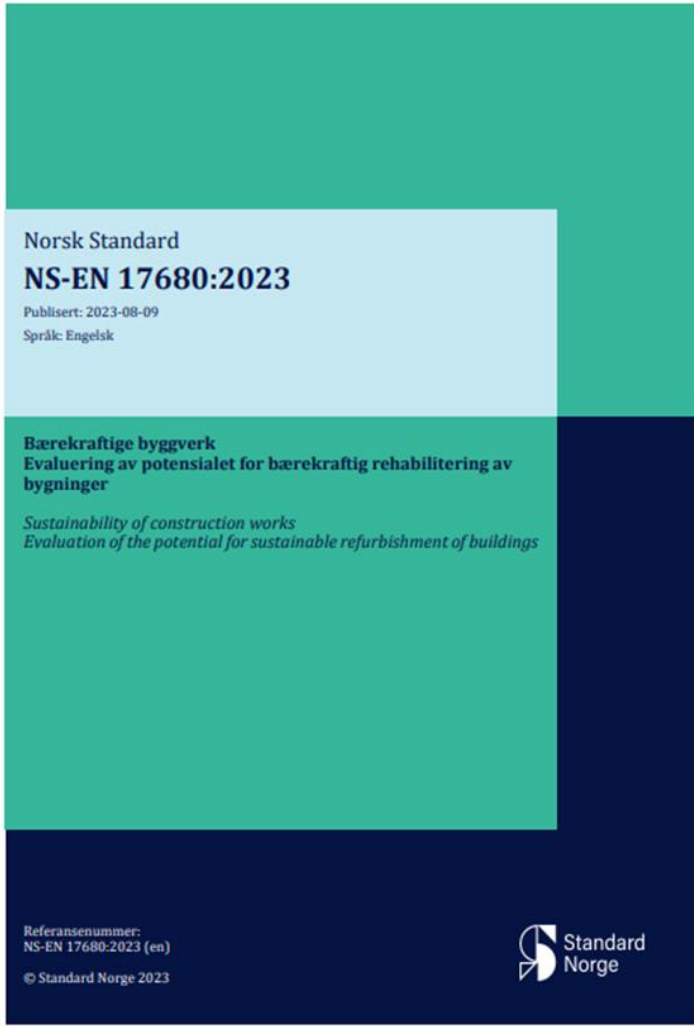
Norges bygg- og eiendomsforening

NS-EN 17680:2023
Sustainable Construction
“Evaluation of Sustainable Refurbishment potential”



Standardmorgen 4. April 2024

Professor emertitus Svein Bjørberg, Multiconsult / NBEF

Norges bygg- og eiendomsforening

Stort potensial i eksisterende bygningsmasse til å tilfredsstille nye trender og krav

ca 400 millioner m2 bygg (ca 2/3 er boliger) + ca 40 millioner m2 hytter

- **Demografisk utvikling:**
  - 80% av verdens befolkning ender i byer / tettsteder: sosial utfordring
  - Økende antall enslige husholdninger: ca 55% i Oslo
- **Klimaendringer**
  - Påvirkning på bygg og områder
- **Sirkulær økonomi**
  - Gjenvinning, gjenbruk, lang levetid på hele bygg gir stor gevinst
- **Taksonomi**
  - Grønne bygg, brune bygg

Norges bygg- og eiendomsforening

Vedtak og signaler fra EU

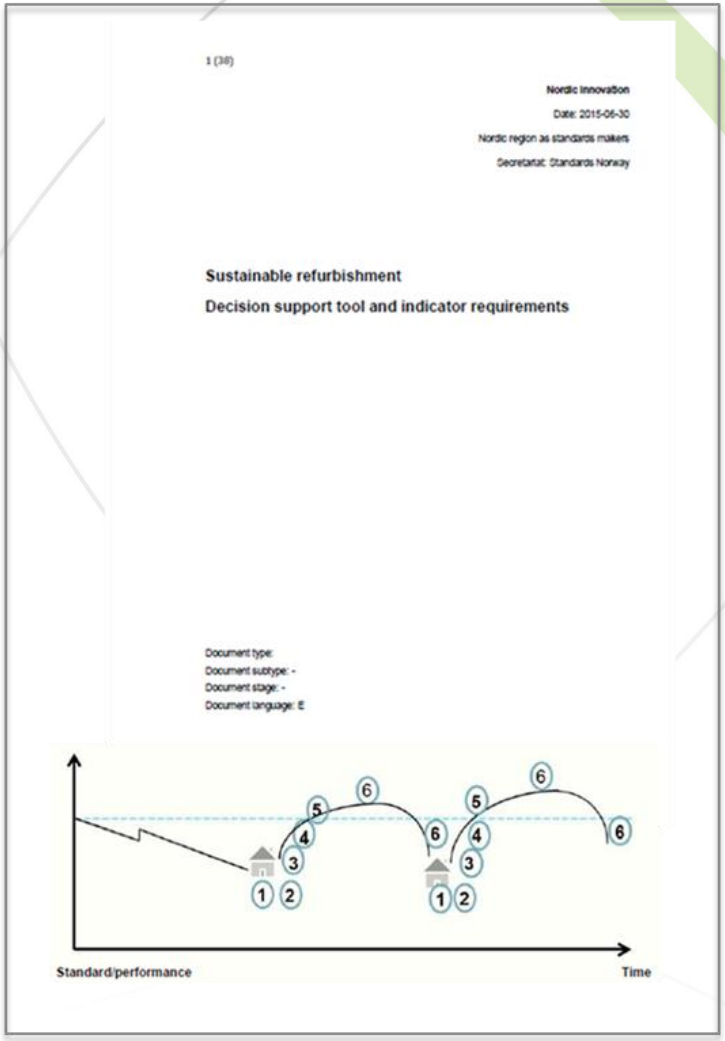
- **Vedtak i EU:** Ombygging av 35 millioner bygg 2020 – 2030
  - Stor gevinst i bygg med **gener for et langt liv**
  - Pro rata innbyggertall**: 4.200 bygg pr år i Norge** (utgjør 1,2% av våre bygg)

- **Signal fra EU**: nye krav i EPBD (Energy Performance Building Directive),
  - Målene for eksisterende
    - **boligbygg** til energimerke **E** (2030) resp **D** (2033)
    - **næringsbygg** til **E** (2027) resp **D** (2030)

- **Er dette mulig å nå i Norge???**

Startpunkt i Norge: Nordisk Ministerråd

- To runder
  - 2009: Nettverk i nordisk byggeindustri
  - 2011: Nordisk region skal være ledende i det grønne skifte
- Nordic Innovation Center (NICe)
  - 2012: Utpekte 3 områder hvorav
    - **Sustainable Refurbishment of excisting buildings**
    - 2015: Ferdig rapport juni
    - 2017: Dansk Standard foreslår rapporten som grunnlag til EU-standard
- Sekretariat hos Standard Norge
  - ✓ Oppstart jan 2018, ferdig august 2023
  - ✓ Prosjektleder: Svein Bjørberg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Nordic Innovation

Date: 2015-06-30

Nordic region as standards makers

Secretariat: Standards Norway

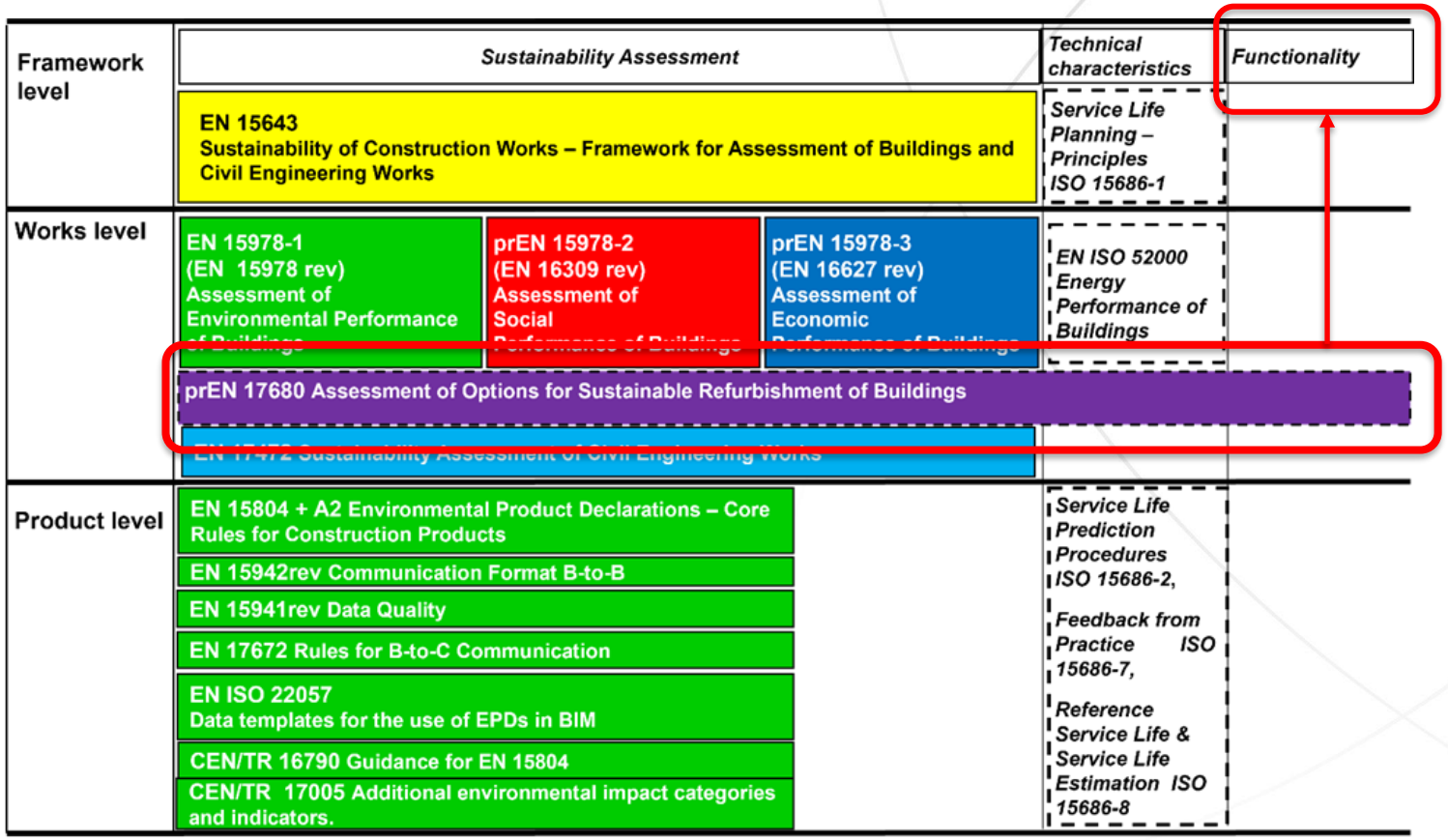
Sustainable refurbishment

Decision support tool and indicator requirements

Document type:
Document subtype: -
Document stage: -
Document language: E

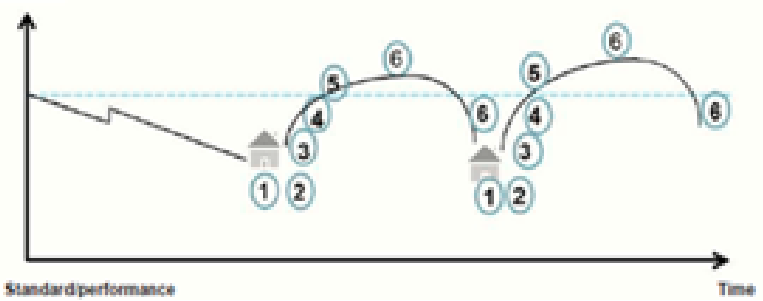
Norges bygg- og eiendomsforening

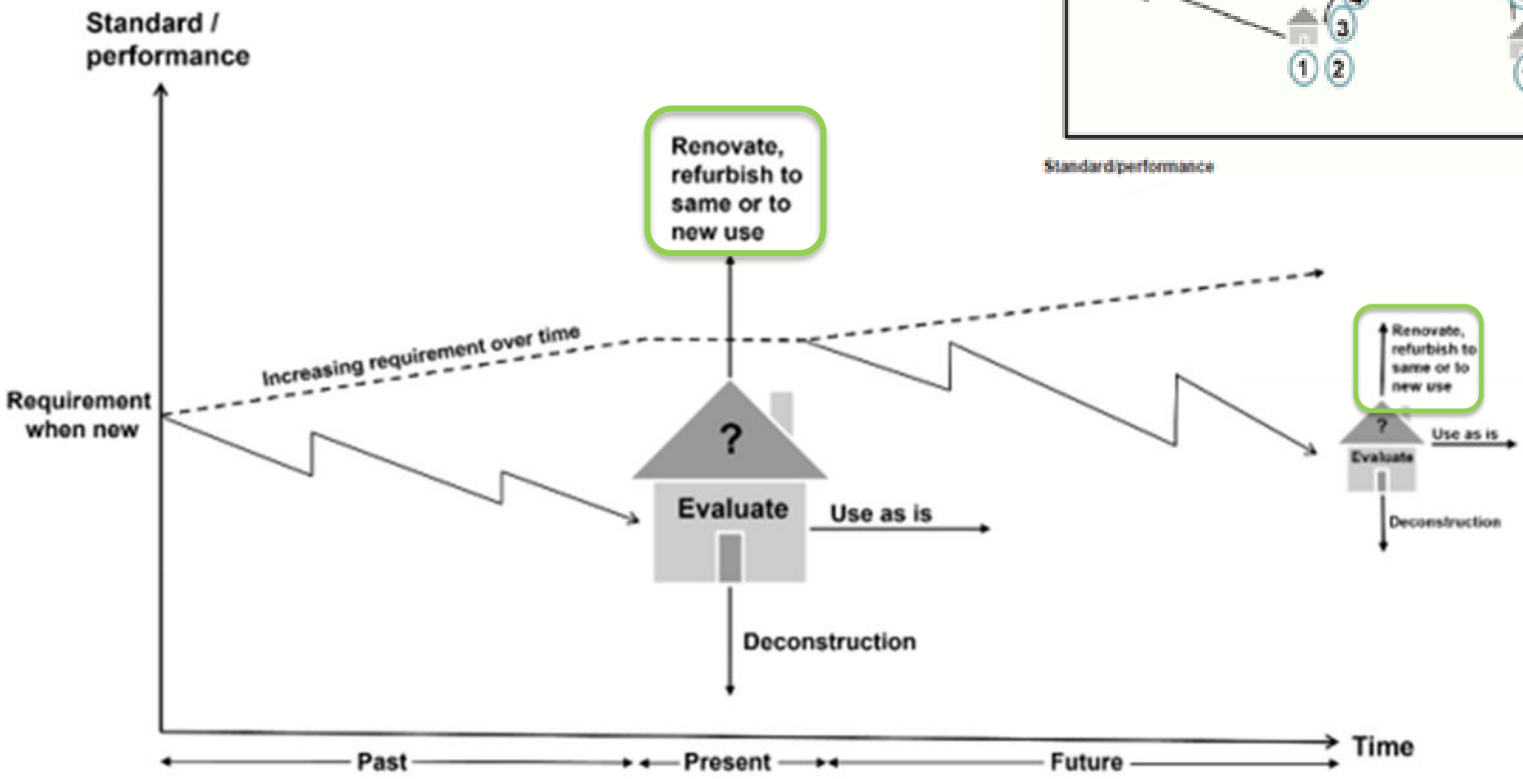
TC 350: Sustainability of construction works



(Ref.: NS-EN 17680:2023, figure 1)

Decision methodology process





(Ref.: NS-EN 17680:2023, figure 2)

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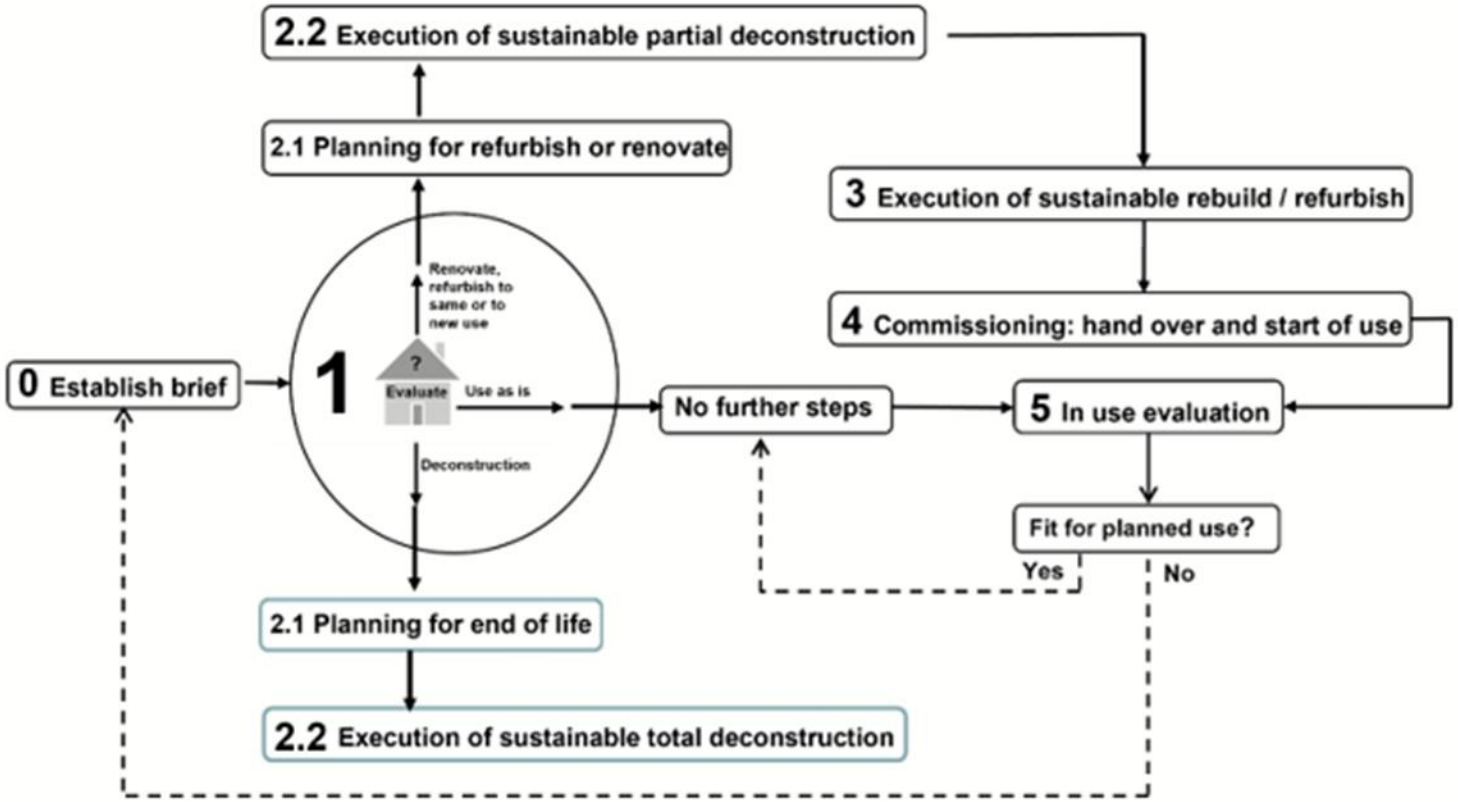
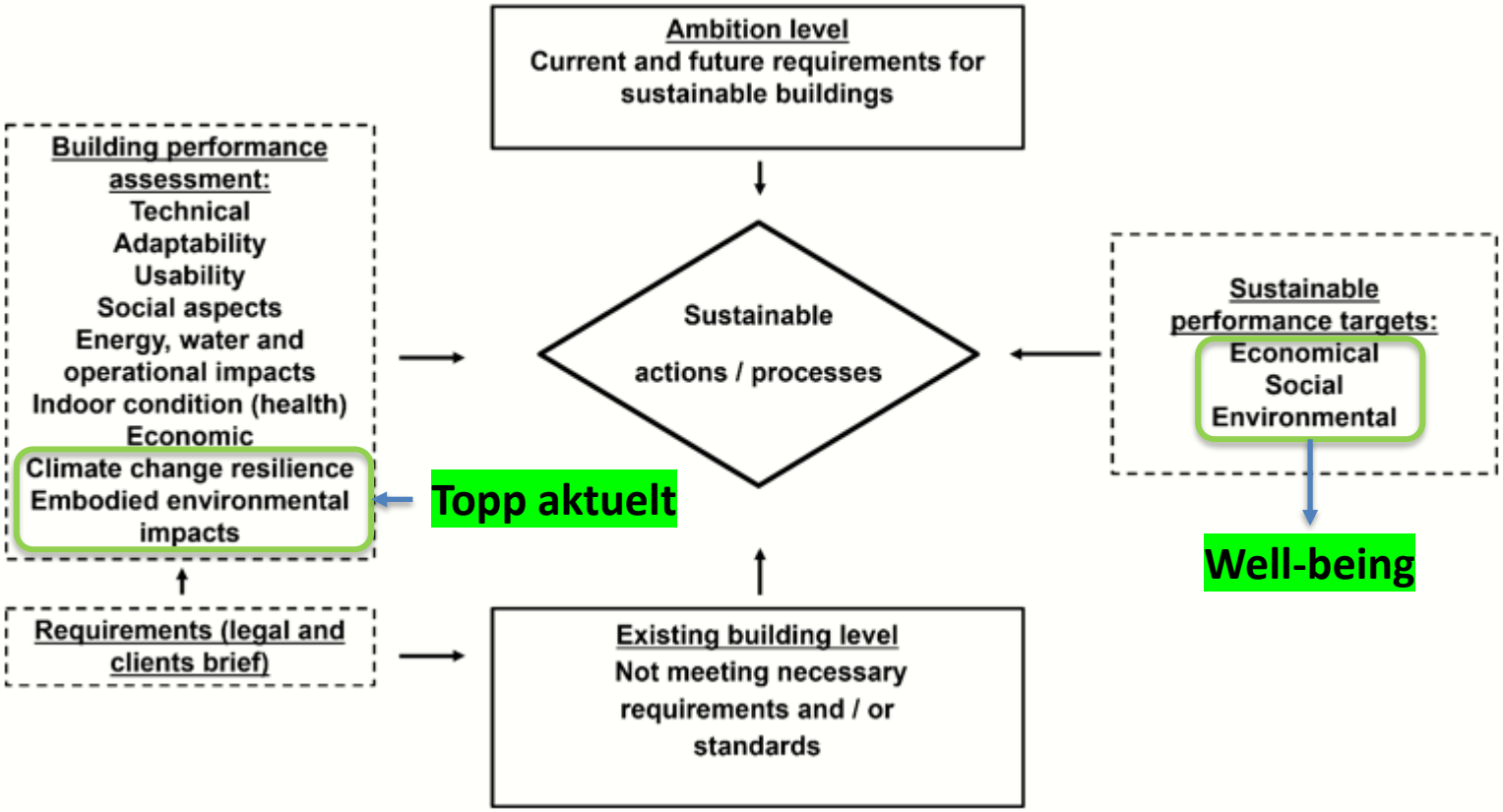
Decision flowchart



(Ref.: NS-EN 17680:2023, figure 6)

Bridge (closing) the gaps



(Ref.: NS-EN 17680:2023, figure 3)

Norges bygg- og eiendomsforening

Main categories for assessment

My point of view:
Important starting point

Main categories	Numbers of indicators	Exemplified description
Technical	18	The costs for upgrading a building which has not been well maintained, and/or has significant failures may be very high in relation to both payback and sustainability.
Adaptability	14	Adaptability should allow for changes in circumstances, either within the building (such as change of use), or its local environment (urban planning, climate change), flexibility (possibility to change space distribution), generality (possibility to change the function of building) and expandability (possibility to change volume). The cost of adaptability can be decreased where it has been factored into the design of walls, floors, and other load bearing elements to allow for potential future changes in use or layout.
Usability	7	Poor usability levels will lower productivity of building user(s).
Social aspects	4	Poor architectural and urban quality can have a long-lasting negative effect on social and cultural value of space.
Energy and water (operational impacts)	4	Overuse of resources can have negative impact on efficiency and environment.
Indoor environment (including health aspects)	12	A poor indoor environment and/or poor indoor air quality can have a negative impact on the efficiency, productivity, creativity, comfort, and general health and wellbeing of the building occupants.
Economic	5	Total costs for refurbishment should be estimated as a consequence of performance classes found for technical, usability, adaptability and indoor climate related to possible income.
Climate change resilience	6	The design of the building, construction works, and materials used should attempt to mitigate the negative impacts of climate change, rising sea levels, flooding, avalanche, seismic activity, and extreme weather events.
Embodied environmental impacts	1	Assessment method shall be in accordance with EN 15978.

(Ref.: NS-EN 17680:2023, table 2)

Norges bygg- og eiendomsforening

Examples on indicators

Topp aktuell etter «Hans»

Technical 18	Foundation-load bearing system. Windows/doors in facades Balconies Roof Indoor surfaces (ceilings, floors, walls) Inventory (fixed)sanitation Heating Ventilation system/ventilation rate Air-conditioning Fire protection (active and passive) Security Electrical system lighting IT-Communication Lifts Waste handling in use Outdoor technical systems Ground-drainage Seismic behaviour	
Climate change adaptation and resilience 6	Extreme weather conditions (wind load, rain, ...) Materials and details of buildings envelope Increase of sea level Flooding Landslide Avalanche	The building The site
Adaptability 14	**Flexibility / generality:** Net floor to ceiling height Load bearing capacity (floors) Vertical space for installations Possibility for holes in slabs Amount of space on each floor Possibility to open space Width of communication areas Inner walls Width of building Lift **Elasticity:** Site situation Vertical and foundations load bearing capacity	Within the building The building

(Ref.: NS-EN 17680:2023, table 3)

Norges bygg- og eiendomsforening

Example of classification of indicators in performance classes, from 0 – 3

Technical (5 out of 18) and Adaptability (8 out of 14)

Indicator	Class 0	Class 1	Class 2	Class 3
Net floor to ceiling height (Indicator 1)	x > 4,0 m. (or that the over or underlying floor is a technical mezzanine)	3,5 m < x ≤ 4,0 m	3,0 m < x ≤3,5 m	x ≤ 3 m
Load bearing capacity floors (Indicator 2)	x >5 kN/m²	4 kN/m² - 5 kN/m²	3 kN/m² - 3,9 kN/m²	< 3 kN/m²
Vertical space for installations (Indicator 3)	Large and/or several shafts providing large space for expansion and/or new vertical transmissions (alternatively technical towers	Shafts size and/or several shafts providing possibility for expansion and /or vertical shafts	Shafts size and/or several shafts providing a limited / remote for expansion and /or vertical shafts	Small shafts and / or number of shafts providing a very little space for expansion and /or new vertical shafts. No residual capacity
Create openings in structural element. (Indicator 4)	Well adapted for creating new openings (eg. in situ slabs)	Adapted for creating new openings in some areas (eg. prestressed concrete elements)	Restricted opportunity for creating new openings in some areas (eg. prestressed concrete elements)	Not / very restricted opportunity for creating new openings (eg. prestressed concrete elements)
Amount of space on each floor (Indicator 5)	x > xx m²	xx m² < x ≤ yy m²	yy m² < x ≤ zz² m²	x≤ zz m²
Possibility to open space (not communication routes).[a] (Indicator 6)	x > xx m²	xx m² < x ≤ yy m²	yy m² < x ≤ zz m²	x ≤ zz m²
With of communication routes (corridors within the functional range) (Indicator 7)	x > xx m	xx m < x ≤ yy m	yy m < x ≤ zz m	x ≤ zz m
Interior walls (Indicator 8)	No load bearing interior walls, light system walls without bindings to technical installations.	Limited extent of load bearing internal walls in one direction	Heavy inner walls with partial load bearing	Heavy and load bearing inner walls in both directions

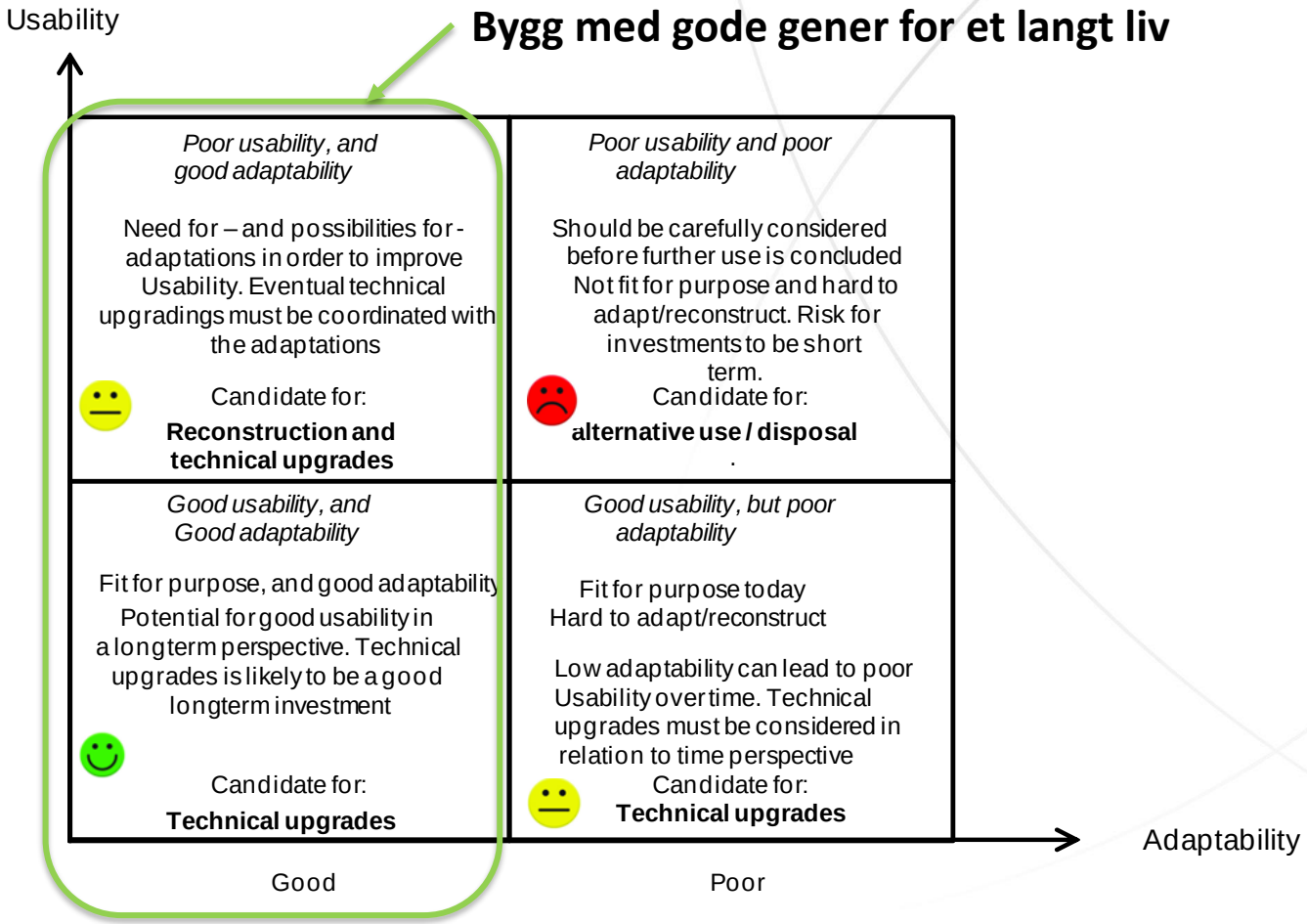
Indicator	Class 0	Class 1	Class 2	Class 3
Foundation-load bearing system (Indicator 1)	Stable foundation founded on / to rock (piles). No risk or sign of settling damages. No sign of weakening of the structural system.	Small signs of settlement cracks, but stable	Stable foundation, a few signs of increasing structural damages. Small signs of weakening (spalling, cracks)	Unstable foundation. Signs of structural cracks or high risk of settlements damages. Signs of deflection or corrosion on reinforcement
Windows, exterior doors (Indicator 2)	No damages, only minor wear on windows/doors of new built standard. Good air tightness	Visual impairments, stiff casements/sash. No signs of decay.	Loose / torn gaskets, small air leaks. Defective coating. Standard insulating glass without low-e coating. Partly need for renovation/replacement	Substantial damages, air leakages, loose corner joint, cracks / decay of material, defect hardware, only single glass. Need for replacement.
Exterior cladding and surface (Indicator 3)	No damages, only minor wear damages on elements of new built standard.	Chipping or spalling of minor extent. No signs of decay or corrosion	Jointed wood or plastering and signs of decay or corrosion. Signs of weathering and spalling.	Substantial damages, cracks, spalling, decay etc. Need for replacement/renovation/ rehabilitation
Roof, gutters, drains (Indicator 4)	No damages, only minor wear damages/ageing on elements of new bulit- standard. Good design of roofing and fittings in connection with drains etc.	Initial growth of moss. Minor signs of wear damages on roofing / deformation of gutters, drains, fittings	Signs of initial damages of roofing. Leakages in gutters and drains. Substantial growth of moss. Need for periodic maintenance.	Substantial damages of roofing, leakages, defect drains etc. Demand for replacement/upgrading
Interior surfaces (floor, wall, ceiling) (Indicator 5)	No damages, only minor wear damages on elements of new built standard. Surfaces are plane and nearly new coating.	Initial wear. Minor cracks and spalling. Wear in areas with heavy traffic.	Partly substantial wear damages or cracks. Need for periodic maintenance.	Substantial damages or extensive wear damages. Need for renovation and rehabilitation/ replacement

(Ref.: NS-EN 17680, table A.1 and A.3)

Genes in a buliding context

- Usability: possibility to satisfy new demands:
  - Adaptability
    - Flexibility: possibility to change space distribution
      - » Ex.: from cell offices to open landscape
    - Generality: possibility to change functionality
      - » Ex.: from office to school
    - Elasticity: possibility to change volume
      - » Ex.: extra floor or/and horizontal extension
- Skin: possibility for a long technical lifetime
  - Maintenance friendly
    - Materials, details and execution that together provide maximum resistance to degradation
      - » Long intervals for maintenance and replacements

The Viability Model

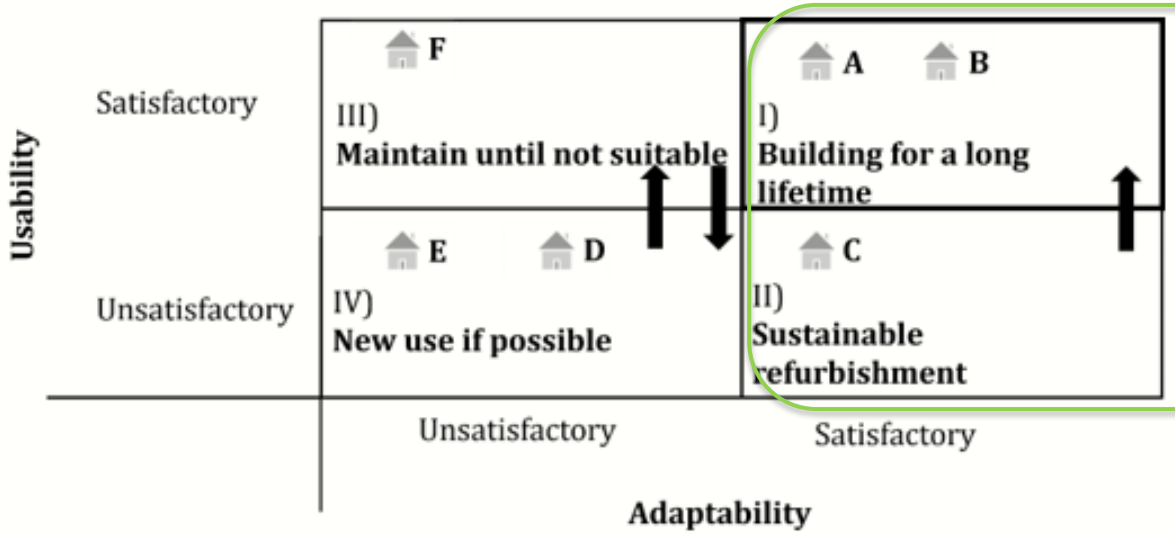


The viability model ("Levedyktighetsmodellen" – the combination of usability and adaptability
(adapted from Larssen and Bjørberg, 2004)

Norges bygg- og eiendomsforening

Communication results

Which buildings are fit for a long lifetime?



Here are buildings which gives:

- long lifetime
  - adaptable
- lovest CO2 emission

Also skin genes

- materials
- details
- execution

Key

Building A and B	Valuable buildings because they have good adaptability and usability. They have the potential to stay in quadrant I) due to the ability to adapt to new demands from core business. Will keep best economy for users and owner
Building C	Can easily be moved from quadrant II) to I) when core business or owner ask for new performance demands
Building D and E	If new use is possible, they can move from quadrant IV) to III). If no new use is possible, and the building is not listed, then recommendation should be sustainable deconstruction.
Building F	Will move to quadrant IV) when core business ask for new performance demands. Recommendation is to maintain with minimum of costs until it achieves unsatisfactory usability.

Ref.: NS-EN 17680:2023 figure 9)

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Further steps in the life cycle of the building(s)

Table 4 — Indicators for sustainable deconstruction

Categories	Indicators for step 2 (2.1 planning related and 2.2 execution related)
Reuse	Components for re-use on site or offsite Materials for recycling Materials for recovery
Waste disposal	Energy recovery from building materials Hazardous waste disposed (safe destruction or deposit/landfill) Non-hazardous waste disposed (safe destruction)
Social (Neighbours, users and workers)	Dust and particles Noise Traffic Vibrations Light pollution Health and safety of workers Health and safety of users in the case of refurbishment in-use conditions Accessibility
Process	Energy for deconstruction Energy for transport

Step 2
Deconstruction

Table 5 — Indicators for commissioning-stage

Categories	Indicators for step 4 Commissioning
Documentation	As Built documents Digital model of the project Guidelines for operation and maintenance[2] Documentation on adaptability Manuals for IT-systems Simple user's manual
Technical Systems	Functionality of integrated systems Airflow proved requirements Security and safety systems Outdoor systems[1]
Operational Competence	Training program fulfilled Organization of MOM (Management, Operation, Maintenance) defined
Approval of the building	Inspection of completion totally finished Surfaces are as described Indoor climate as described (example on criteria for indoor climate is given in table A5)

Step 4
Commissioning

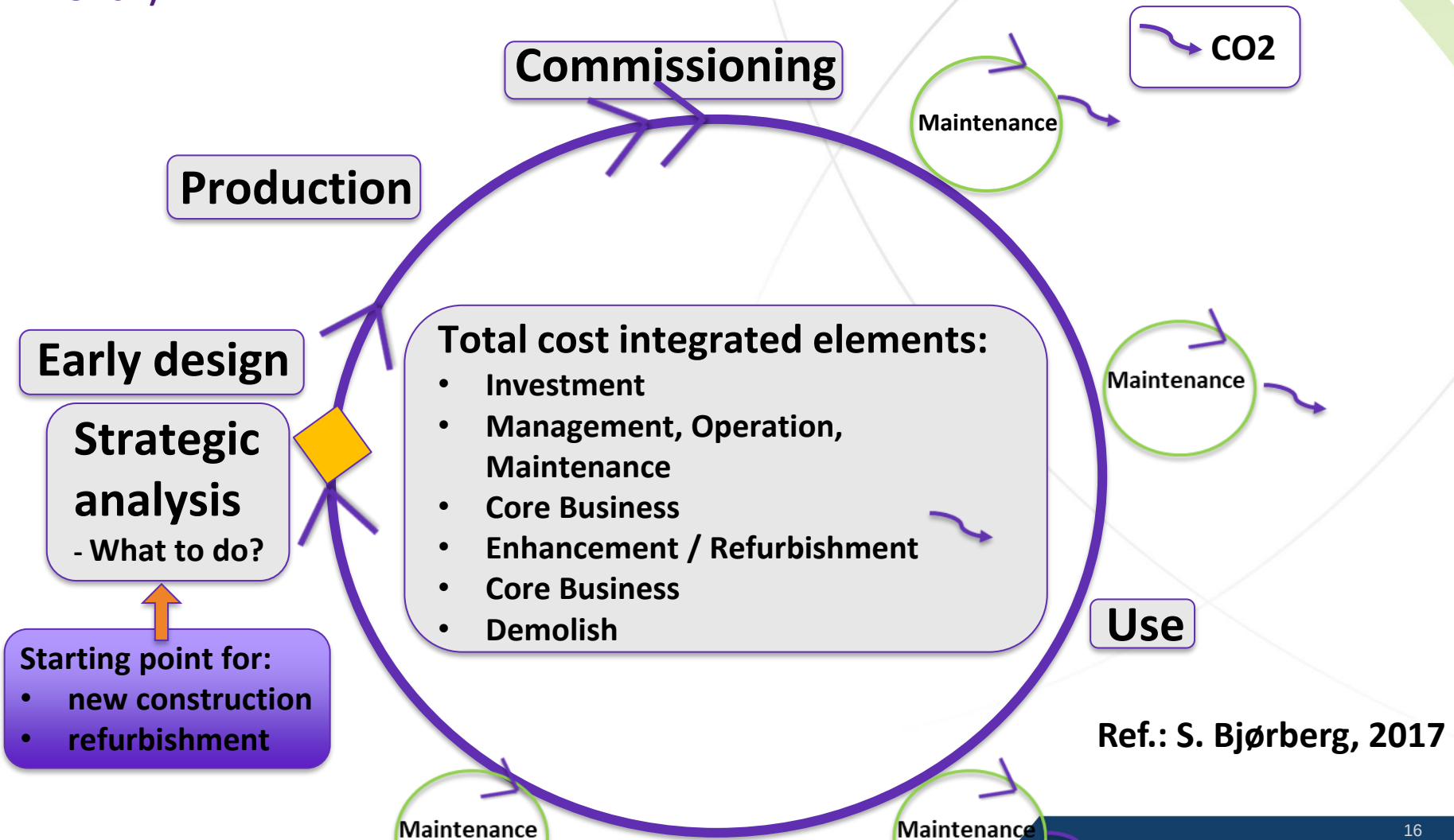
Table 6 — Indicators for in use-stage

Categories	Indicators for step 5
Social	Indoor climate
	Aesthetic environment Acoustic environment (for users of the building and neighbours) Actinic (light conditions) environment (for users of the building and neighbours) Accessibility and Universal Design, see EN 17210:2021 Usability Safety Thermal comfort (for users of the building and neighbours)
Environmental	Material and chemical usage Waste treatment Energy source Energy demand Electricity usage Energy management Water consumption Ecology Nature conservation
Economy	Adaptability Level of Maintenance (technical condition) Location Building certifications Value Life cycle costs

Step 5
Indoor climate

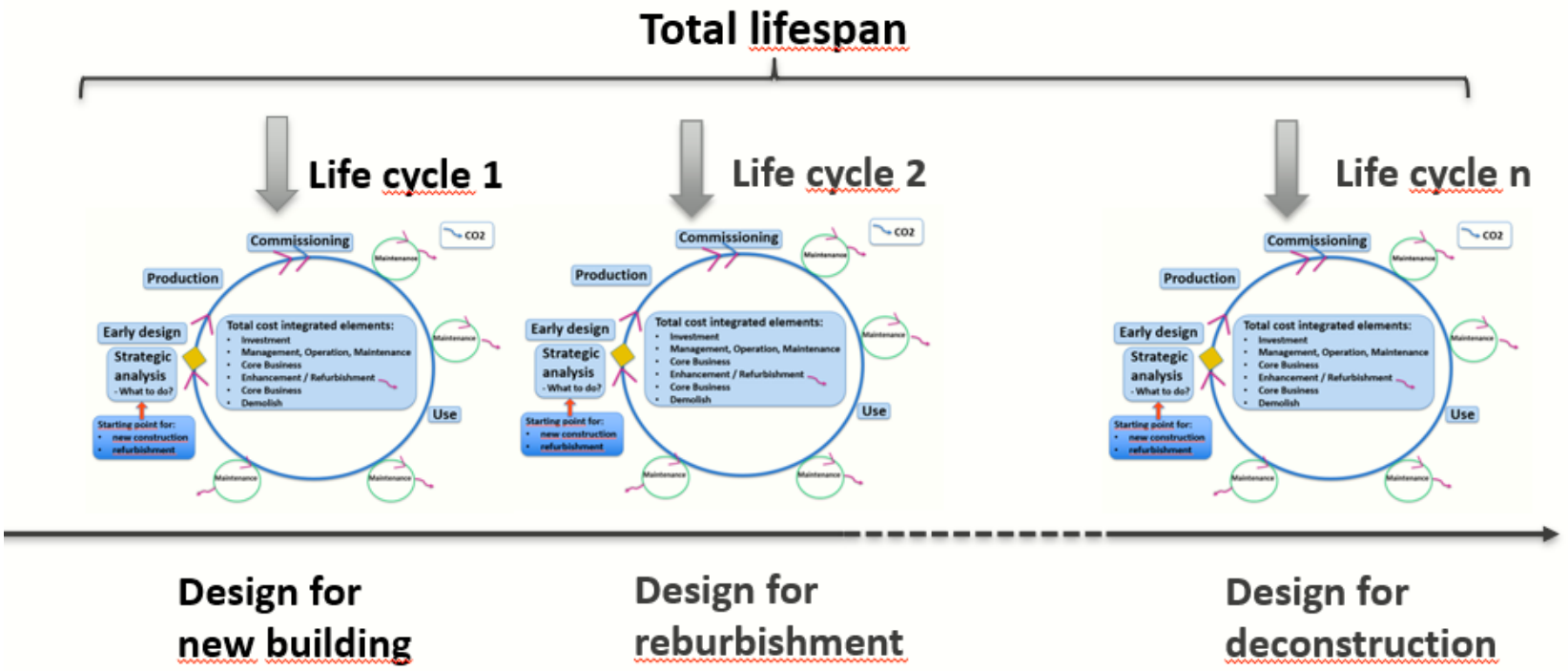
OSCAR GENERIC PHASEPLAN = CIRCULAR PHASEPLAN

(ANALYSIS-DESIGN-PRODUCTION-COMMISSION-USE- MAINTAIN - REFURBISHMENT-DEMOLISH)



Ref.: S. Bjørberg, 2017

New model:
Total lifespan is a sum of n life cycles



How and where to find genes in excisting buildings?

Ref.: S. Bjørberg, 2023

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Spørsmål??

Takk for oppmerksomheten

Svein Bjørberg

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