Architecture, Design and Conservation
Danish Portal for Artistic and Scientific Research

Aarhus School of Architecture // Design School Kolding // Royal Danish Academy

Life Cycle Thinking and Integrated Product Deliveries in renovation projects: Extending the concept of Integrated Product Deliveries with Product Service Systems

Schipull Kauschen, Jan

Publication date:
2012

Document Version:
Peer reviewed version

Link to publication

Citation for pulished version (APA):
Schipull Kauschen, J. (2012). *Life Cycle Thinking and Integrated Product Deliveries in renovation projects: Extending the concept of Integrated Product Deliveries with Product Service Systems*. Paper presented at Sustainable Innovation 2012, Bonn, Germany. http://cfsd.org.uk/events/sustainable-innovation-2012/

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 20. Apr. 2024

ARKITEKTSKOLEN AARHUS Designskolen Kolding Det Kongelige Akademi

Life Cycle Thinking and Integrated Product Deliveries in renovation projects: Extending the concept of Integrated Product Deliveries with Product Service Systems

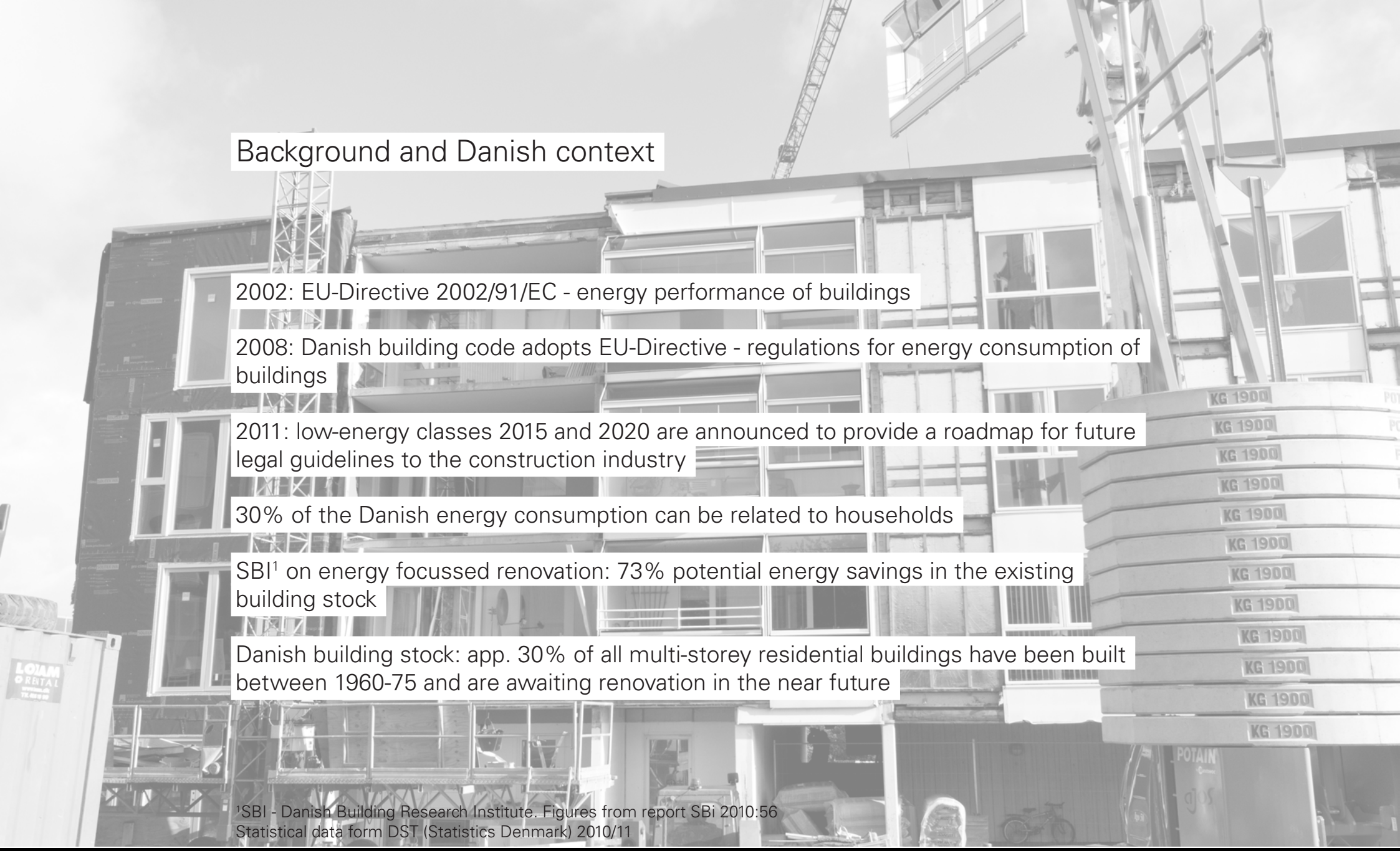
Jan Schipull Kauschen
Architect MAA, Dipl.-Ing. (Arch)
CINARK - Centre for Industrialised Architecture + JJW arkitekter, Copenhagen

The Royal Danish Academy of Fine Arts
Schools of Architecture, Design and Conservation
School of Architecture

Sustainable Innovation 2012 / Alanus University, Bonn / 2012.10.30

OVERVIEW

1. Background and Danish context
2. Market potential for renovation of multi-storey residential buildings
3. Case studies / Political perspective and client requests
4. Integrated Product Deliveries (IPD)
5. Sustainable Integrated Product Deliveries
6. Extending IPDs towards Product Service Systems (PSS)
7. Business opportunities and stakeholder risk-management



Background and Danish context

2002: EU-Directive 2002/91/EC - energy performance of buildings

2008: Danish building code adopts EU-Directive - regulations for energy consumption of buildings

2011: low-energy classes 2015 and 2020 are announced to provide a roadmap for future legal guidelines to the construction industry

30% of the Danish energy consumption can be related to households

SBI[1] on energy focussed renovation: 73% potential energy savings in the existing building stock

Danish building stock: app. 30% of all multi-storey residential buildings have been built between 1960-75 and are awaiting renovation in the near future

[1]SBI - Danish Building Research Institute. Figures from report SBi 2010:56
Statistical data form DST (Statistics Denmark) 2010/11

Market potential for renovation of multi-storey residential buildings in Denmark

56,6 years is the average age of a building in Denmark in 2011

61,5% of all residential buildings are older than 40 years

24,5% of all residential buildings are older than 80 years

33% of the Danish building stock was built between 1950 and 1975 (montagebyggeri)

1,3% of the Danish building stock was built after the new energy regulations came into effect (BR08)

Source: Calculations based on figures from DST (Statistics Denmark), 2010/11

Market potential for renovation of multi-storey residential buildings in Denmark

56,6 years is the average age of a building in Denmark in 2011

61,5% of all residential buildings are older than 40 years

24,5% of all residential buildings are older than 80 years

33% of the Danish building stock was built between 1950 and 1975 (montagebyggeri)

1,3% of the Danish building stock was built after the new energy regulations came into effect (BR08)

35% of all multi-storey residential buildings are owned by social housing companies (80% owned by 80 companies)

57% of those have been built between 1950 and 1975 (app. 356.000 apartments)

Source: Calculations based on figures from DST (Statistics Denmark), 2010/11

Market potential for renovation of multi-storey residential buildings in Denmark

56,6 years is the average age of a building in Denmark in 2011

61,5% of all residential buildings are older than 40 years

24,5% of all residential buildings are older than 80 years

33% of the Danish building stock was built between 1950 and 1975 (montagebyggeri)

1,3% of the Danish building stock was built after the new energy regulations came into effect (BR08)

35% of all multi-storey residential buildings are owned by social housing companies (80% owned by 80 companies)

57% of those have been built between 1950 and 1975 (app. 356.000 apartments)

10% of the Danish population resides in multi-storey residential buildings, owned by social housing companies

Source: Calculations based on figures from DST (Statistics Denmark), 2010/11

Case studies
Political perspective

"The subsidized housing sector should be pioneering construction, and ensure the achievement of the highest quality for the best price, not only in respect to technical and functional qualities, but also qualities such as architecture, accessibility and the minimizing of environmental impacts related to construction. Owners of subsidized housing units should through their building activity help to develop the building sector, help to build-up new skills and promote the new industrialisation of the construction industry."

translated from: "Byggeriets Fremtid – fra tradition til innovation"
(The Danish Agency for Trade and Industry (EFS) 2000, p.67)

Case studies

Urbanplanen, Copenhagen (2005 - 2009)
Rækkehusene, Brøndby Strand (2006 -)
Heimdalsbej, Frederikssund (2010 -)
Fælledgården, Copenhagen (2010-12)

before renovation

during/after renovation

Life Cycle Thinking and Integrated Product Deliveries in renovation projects:
Extending the concept of Integrated Product Deliveries with Product Service Systems

Jan Schipull Kauschen // CINARK+JJW

Case studies
Client requests

Clients from the public sector demand:

economic security (construction + operation)

high workmanship quality (-> less defects)

least inconveniences for their tenants during the construction period

energy savings during operation phase (-> economy)

lifetimes of building components of at least 30 years (-> economy)

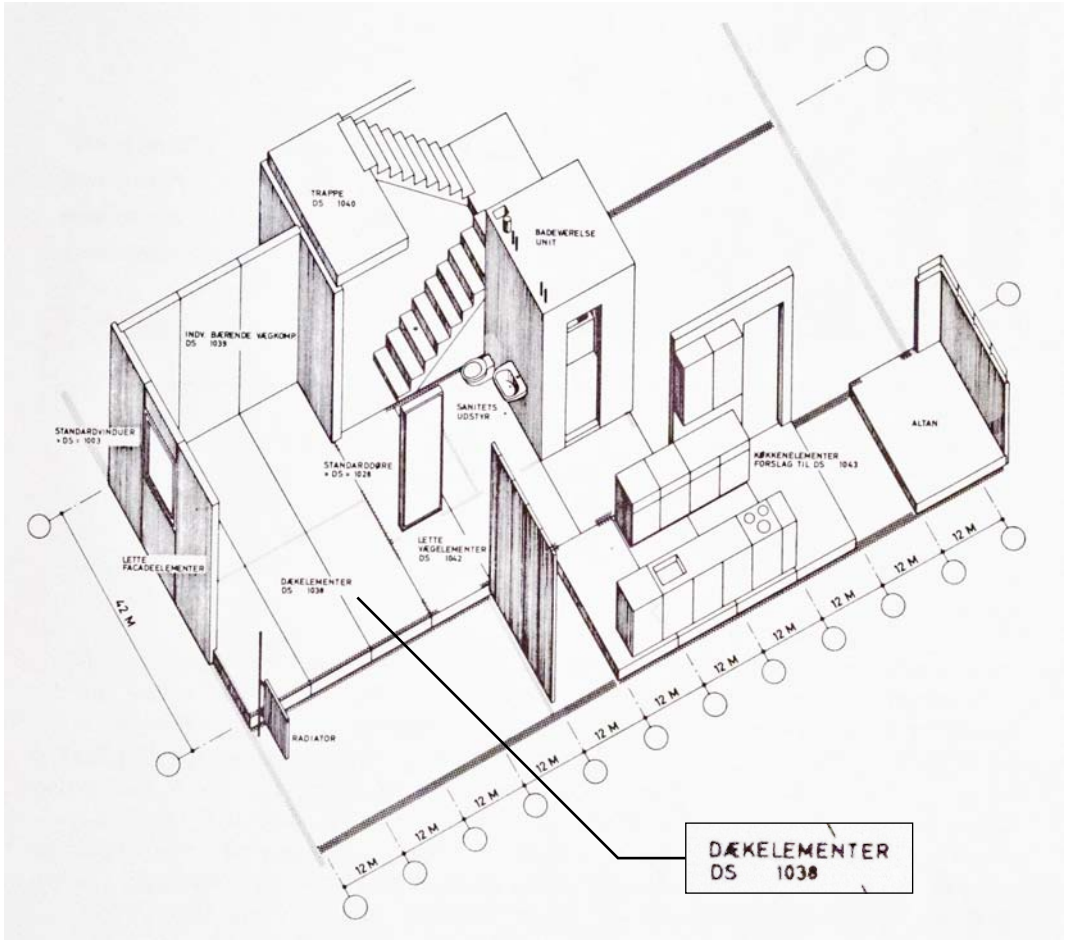
Heimdalsvej, Frederikssund
Oktober 2011

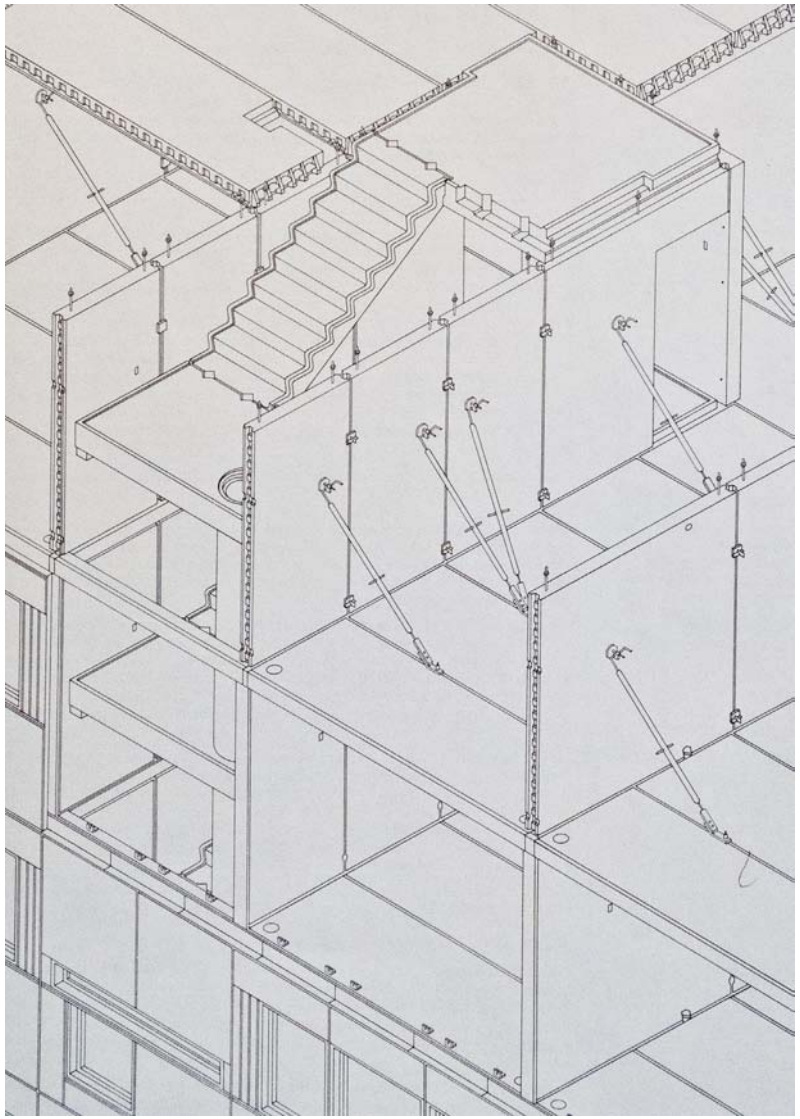
Life Cycle Thinking and Integrated Product Deliveries in renovation projects: Extending the concept of Integrated Product Deliveries with Product Service Systems

Sustainable Innovation 2012 / Alanus University, Bonn / 2012.10.30

Jan Schipull Kauschen // CINARK+JJW

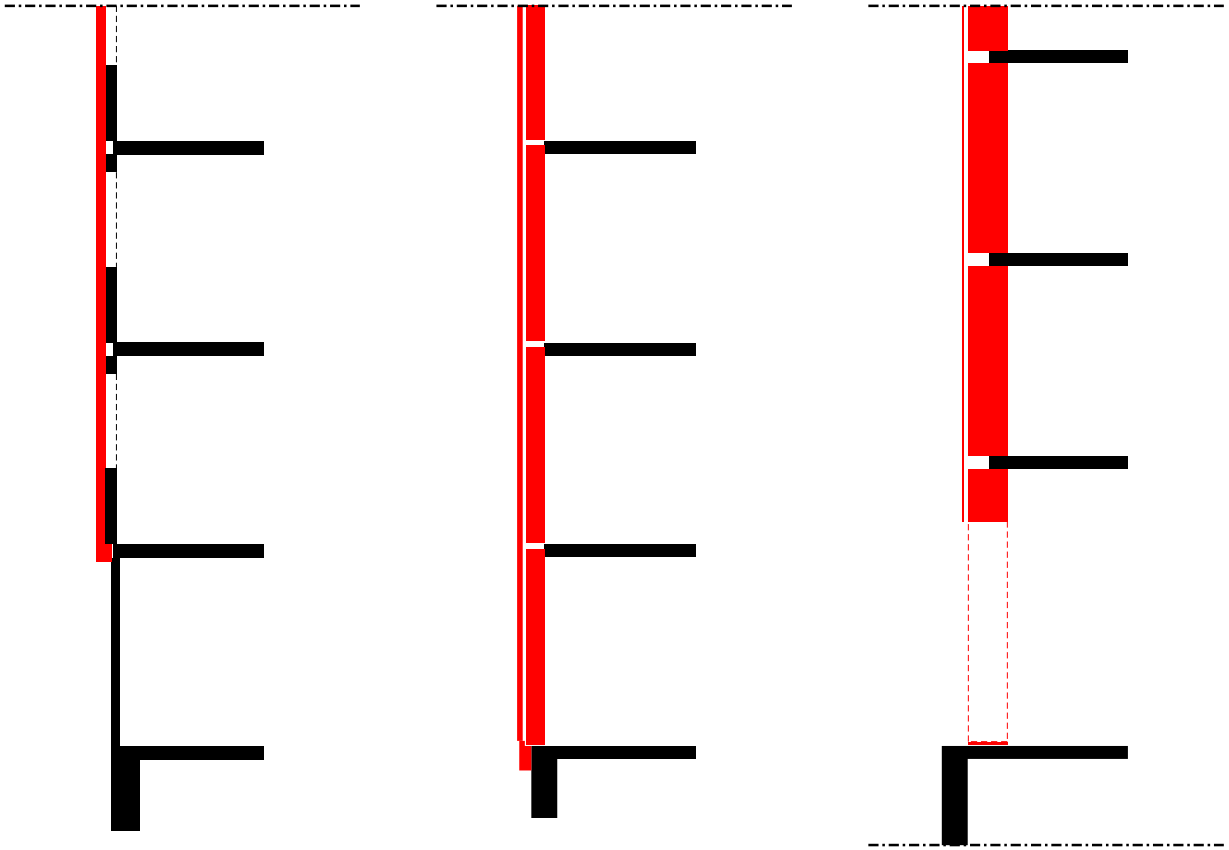
Case studies
The Open System (Povl E. Malmstrøm)





left: standardised elements for apartment buildings / right: The Jespersen System.
Source: Nissen, H. 1984. Montagebyggeri

Case studies
Ease of renovation 2050 ?



Urbanplanen Heimdalsvej Fælledgården

construction princicples / facade sections

Heimdalsvej
prefab facade elements are clad with ETIC System on-site

Life Cycle Thinking and Integrated Product Deliveries in renovation projects: Extending the concept of Integrated Product Deliveries with Product Service Systems

Sustainable Innovation 2012 / Alanus University, Bonn / 2012.10.30

Jan Schipull Kauschen // CINARK+JJW

Integrated Product Deliveries (IPD)

1. Modules with a specified function
   and specified interfaces to other modules

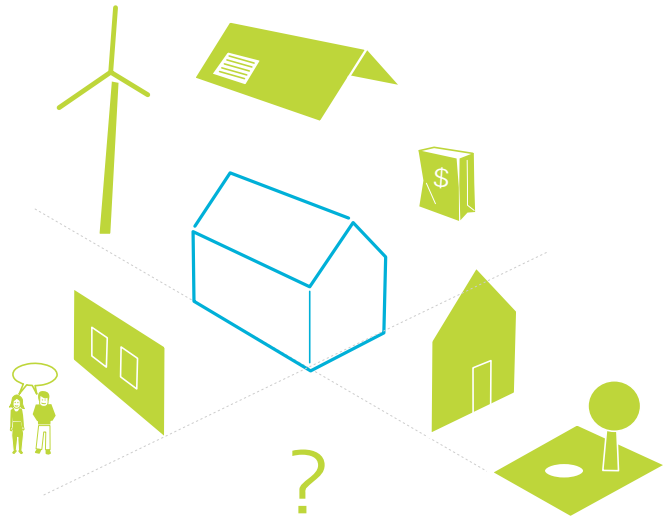
2. Producer offers product configuration
   (mass customization)

3. Production in an industrial context, allowing higher quality at
   lower costs (possibly prefabrication)

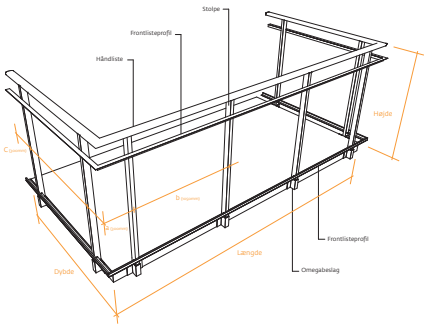
4. Services can/should be included
   (e.g. planning support, assembly, maintenance)

5. The IPD offers a solution for a certain need in a building
   project (e.g. interior climate solution)

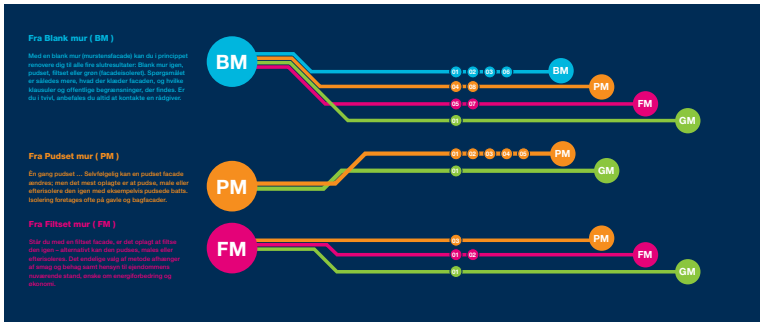
Advantage:
Reduction / integration of complexity of building products,
components and services



Integrated Product Deliveries (IPD) - Examples



Altan.dk - "the balcony dream"



RBE (Ringsteds Byggeenterprise) - Renovation of masonry facades

Bathroom pods

NCC - prefab shaft sytstem

Installation of the shaft system at the residential care home for the eldery, Ørestaden / Copenhagen / JJW arkitekter

Sustainable Integrated Product Deliveries

Sustainability has not been a key parameter in the development of recent IPDs

but,

use of low-maintenance and/or certified materials (e.g. altan.dk)

reduction of material use and efficient production in factories (e.g. NCC shaft)

focus on working environment at the production facilities

Source: Beim, A., J. Nielsen, K. Sanchez Vibæk. 2010. *Three Ways to assemble a house*. KADK.

Sustainable Integrated Product Deliveries

1
sustainable by design:

material choice,
production method,
longevity / robustness
potential for recycling/reuse

e.g. use of sustainable materials
to reduce initial environmental impacts

socially responsible production

optimal lifetimes for product purposes

reuse / recycling concepts and guarantee

2
sustainable through operation:

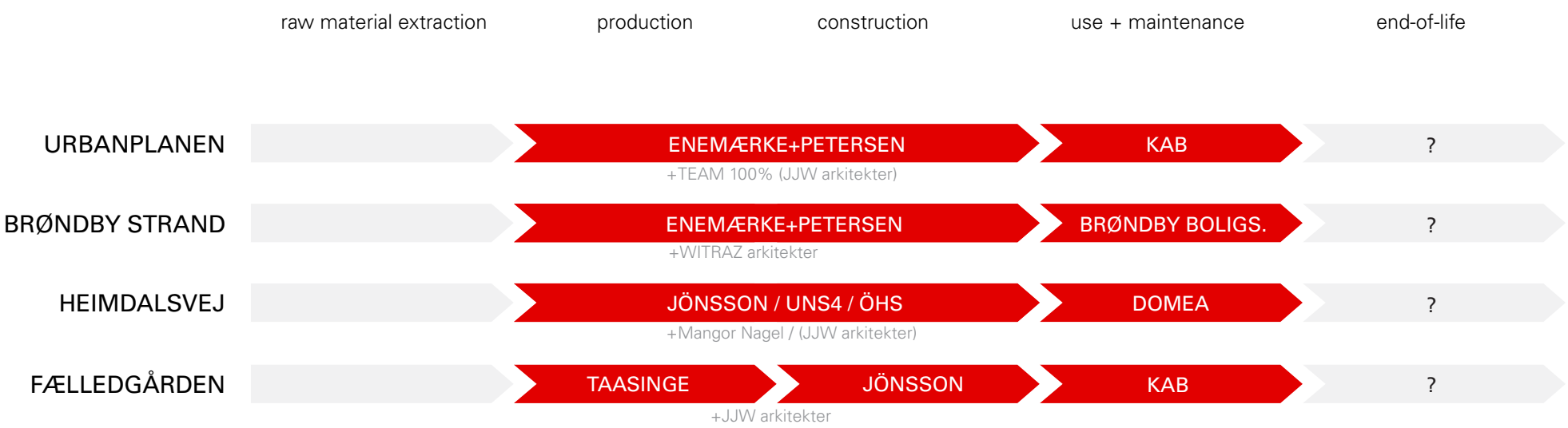
use of the IPD increases the
sustainabilty of a building project

e.g. technical solutions to reduce
energy consumption

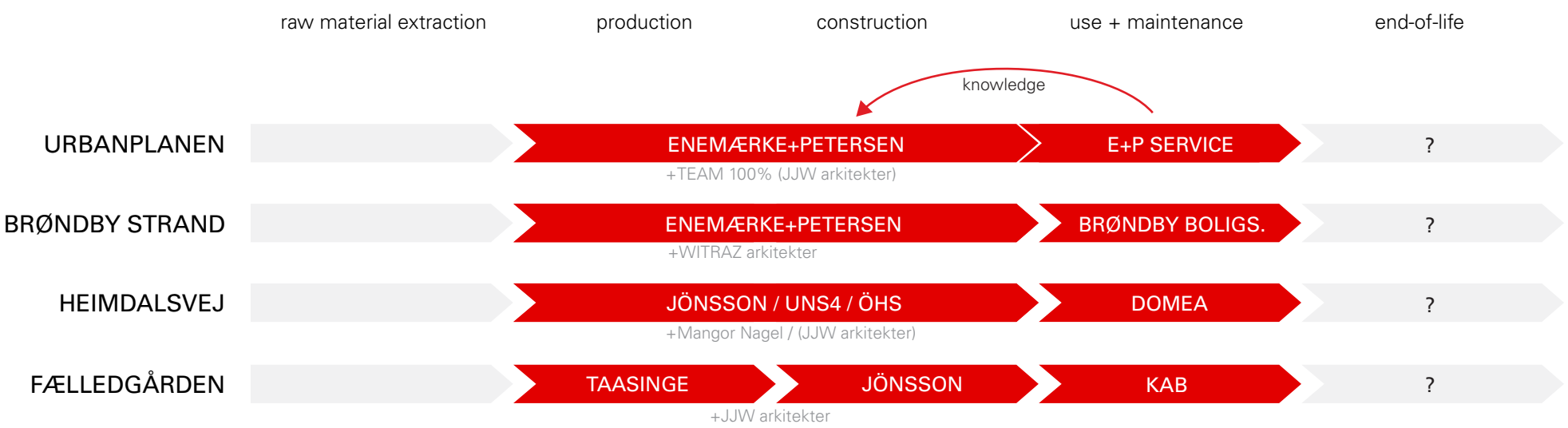
systems that allow easy adaption / use
change

service that affects user behaviour

Case studies
Lifecycle stages and responsibilities



Case studies
Lifecycle stages and responsibilities

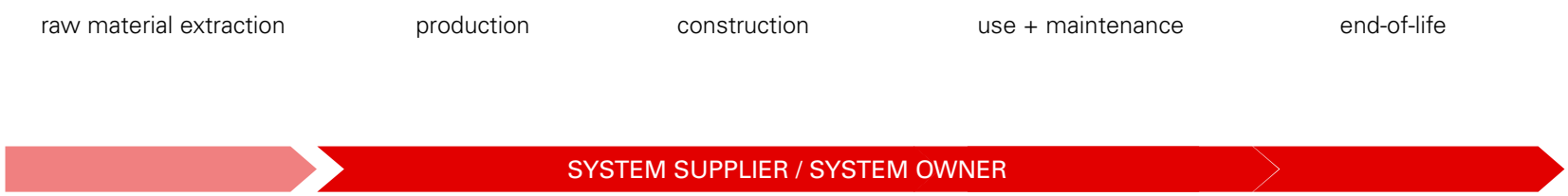


Extending IPDs towards Product Service Systems (PSS)

"The sale of products does not encourage a closed cycle economy because at the point-of-sale the responsibility for the user phase and the disposal is transferred to the customer; it is the customer who decides what is to happen to the product after use.
The sale provides no incentive for the manufacturer to supply goods, which have a long life or are reusable."

(Mont, O., 2000. Product Service Systems, p.35)

Extending IPDs towards Product Service Systems (PSS)



The system supplier controls all life cycle stages, from production to end-of-life
sourcing of greater amounts of raw materials allows upstream influence
or
reuse of materials will lower the necessary new, raw material input

Clients are offered a one-stop solution for the construction project and maintenance during the use stage, as well as greater economic confidence in building and maintenance costs
-> a building solution can be offered

challenges for system suppliers in the building branch:
great uncertainty caused by long life cycle (50 years +)
low value of building materials -> low incentive for remanufacturing / re-use / recycling
legal issues concerning ownership of building components
legal issues with ownership of product-related rights -> open system?

Extending IPDs towards Product Service Systems (PSS)

"A product-service system (PSS) is

- *a pre-designed combination of products and services in a market that can fulfil consumers' needs; and*
- *a de-materialised solution to consumer needs and preferences; ("leasing" / "service")*
- *a result of rethinking of the product value chain and ways of delivering utility to customers that will have a smaller environmental impact than separate products and services outside the system."*

(Mont, O., 2000. Product Service Systems)

Extending IPDs towards Product Service Systems (PSS)

IPDs

✓

"A product-service system (PSS) is

- *a pre-designed combination of products and services in a market that can fulfil consumers' needs; and*
- *a de-materialised solution to consumer needs and preferences; ("leasing" / "service")*
- *a result of rethinking of the product value chain and ways of delivering utility to customers that will have a smaller environmental impact than separate products and services outside the system."*

(Mont, O., 2000. Product Service Systems)

Extending IPDs towards Product Service Systems (PSS)

IPDs ✓ ○

"A product-service system (PSS) is

- *a pre-designed combination of products and services in a market that can fulfil consumers' needs; and*
- *a de-materialised solution to consumer needs and preferences; ("leasing" / "service")*
- *a result of rethinking of the product value chain and ways of delivering utility to customers that will have a smaller environmental impact than separate products and services outside the system."*

(Mont, O., 2000. Product Service Systems)

Extending IPDs towards Product Service Systems (PSS)

IPDs

✓ ○ –

"A product-service system (PSS) is

- *a pre-designed combination of products and services in a market that can fulfil consumers' needs; and*
- *a de-materialised solution to consumer needs and preferences; ("leasing" / "service")*
- *a result of rethinking of the product value chain and ways of delivering utility to customers that will have a smaller environmental impact than separate products and services outside the system."*

(Mont, O., 2000. Product Service Systems)

Design Strategies and PSS

4R's (repair, renovation, reuse, recycle) / Product-Life Extension
(Davis 1977, Stahel 1982)

Shearing Layer Strategy
(Brand/Duffy 1995)

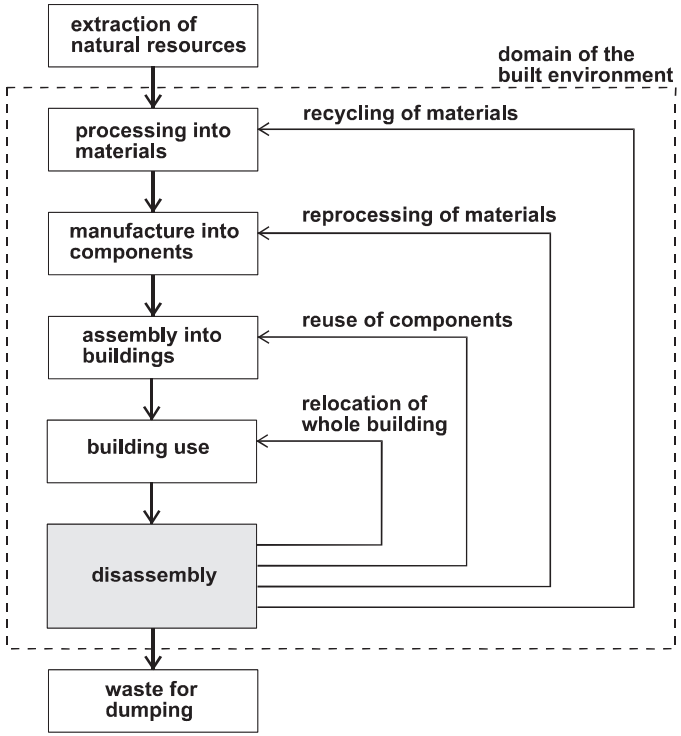
Design for Disassembly / Design for Deconstruction
(Fletcher 2000, Crowther 2000)

-> plan/design lifecycles
-> think the lifecycle of the building in layers

-> enable the exchange of components without affecting other components
-> components: allow recovering of "clean" materials (if the components cannot be reused)

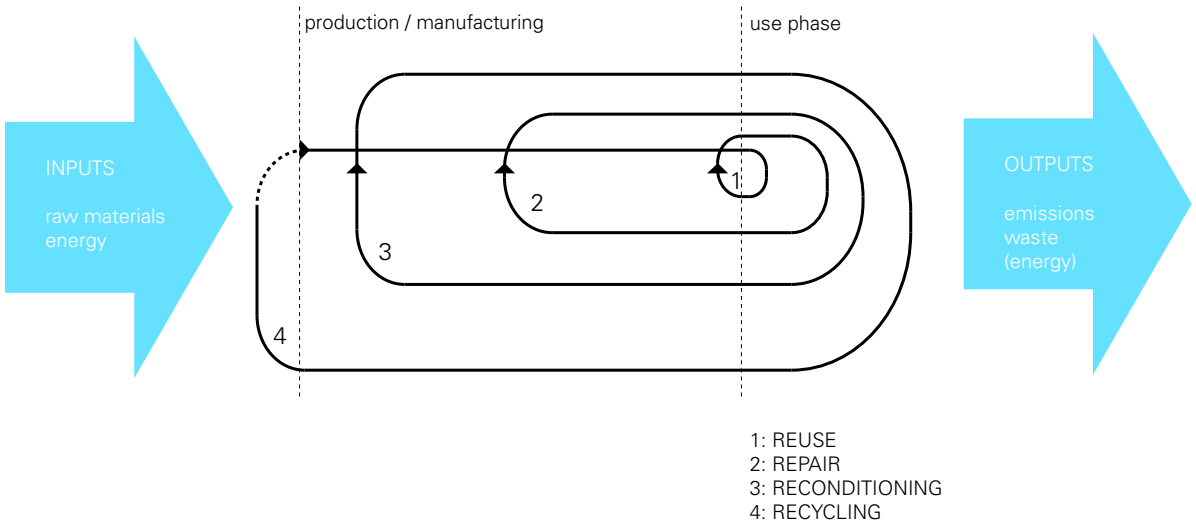
Design for Disassembly:
Cellophane House
Kieran Timberlake, 2008

Design Strategies and PSS



DfD: Possible end-of-life scenarios for the built environment

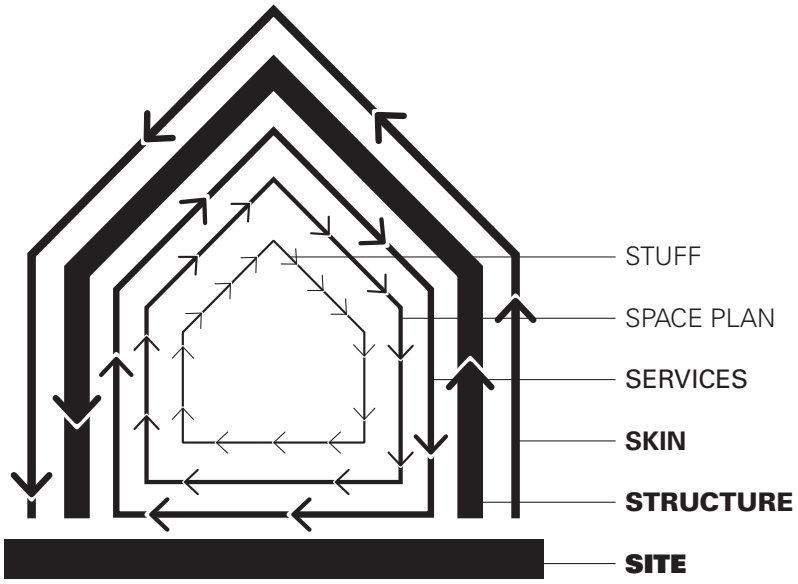
Source: Crowther, P. 2000. Developing an inclusive model for design for deconstruction.



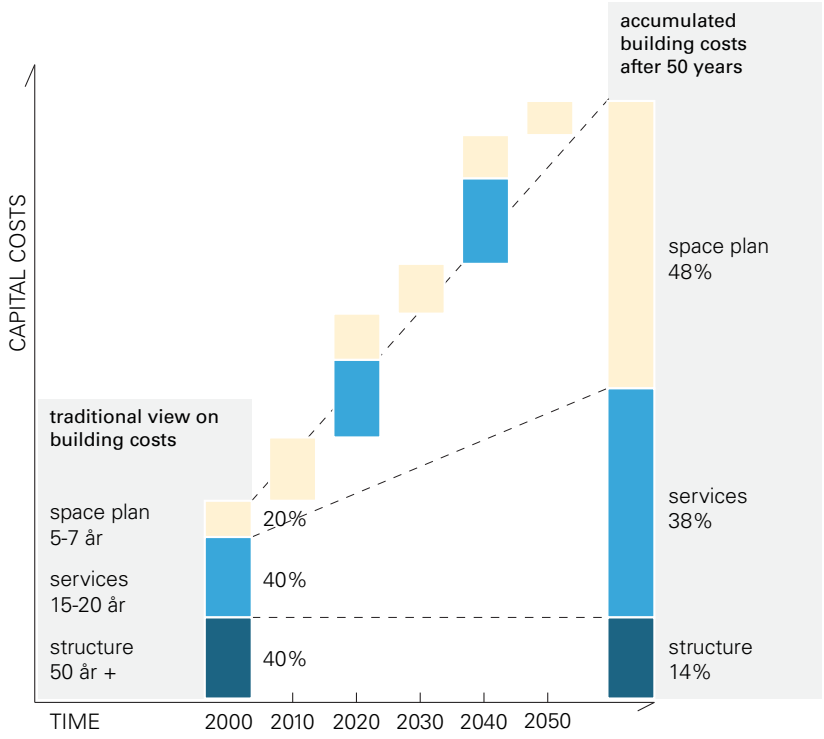
Replenishing Loops (the 4 Rs)

Source: Stahel, W. 1982. Product Life Factor.

Design Strategies and PSS
Building layers and the cost perspective

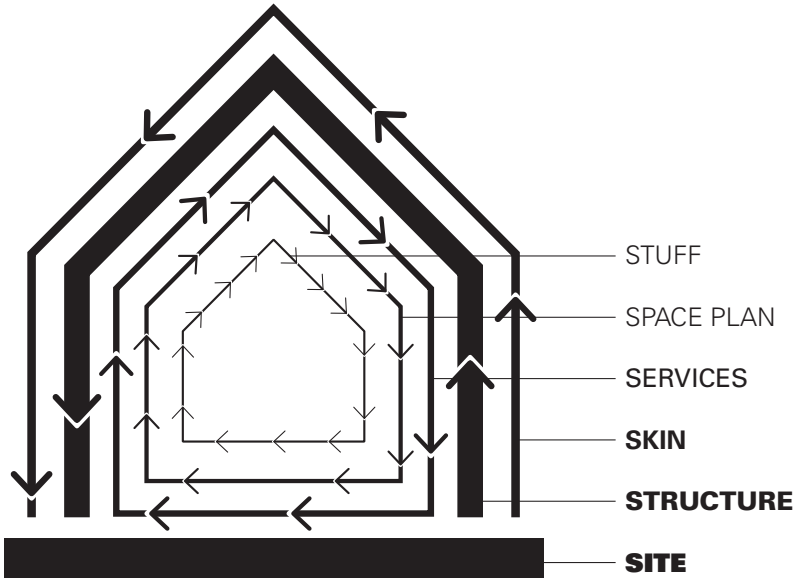


Stewart Brand, 1995 / How Buildings Learn

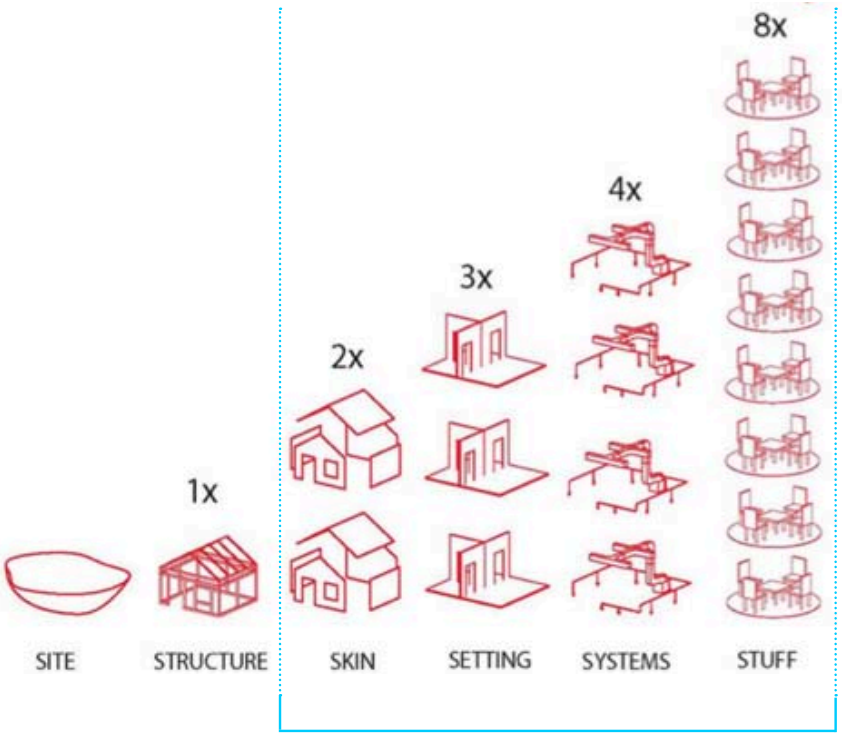


Stewart Brand, 1995 / How Buildings Learn, diagram by DEGW, Francis Duffy

Design Strategies and PSS
Building layers and environmental impacts



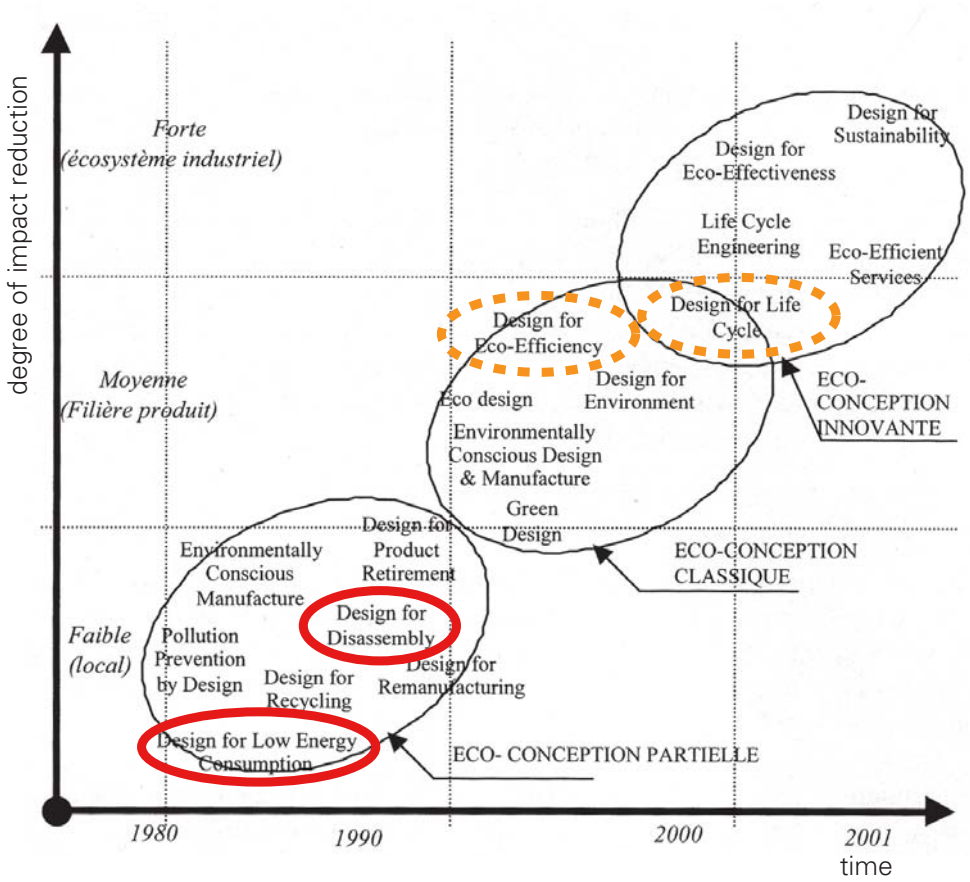
Stewart Brand, 1995 / How Buildings Learn



operation- / use-phase

Source: Cradle-to-cradle Denmark (Vugge til vugge.dk)

Design Strategies and PSS



Dominique Millet, 2003 / Integration de l'environment en conception

Business opportunities and stakeholder risk-management

PSS will allow new ways of sustaining business in the construction sector:

the concept of product-life extension
- will create long-term relationships and dependencies between system owners and clients

- new business opportunities in refurbishing, reconditioning and reuse of system components

- more labour intensive, but less use of resources (refurbished/reused components avoid the production of new componentes -> less use of new materials)

-> contractor as an ESCO?

Business opportunities and stakeholder risk-management

Advantages for clients:

better economical security (construction + operation)

high product quality (industrialised fabrication + extended responsibility)

defined product services (e.g. max. transmission losses, day light factors, comfort)

professional operation and maintenance (through system supplier / owner)

but also:
less environmental impacts
less use of resources

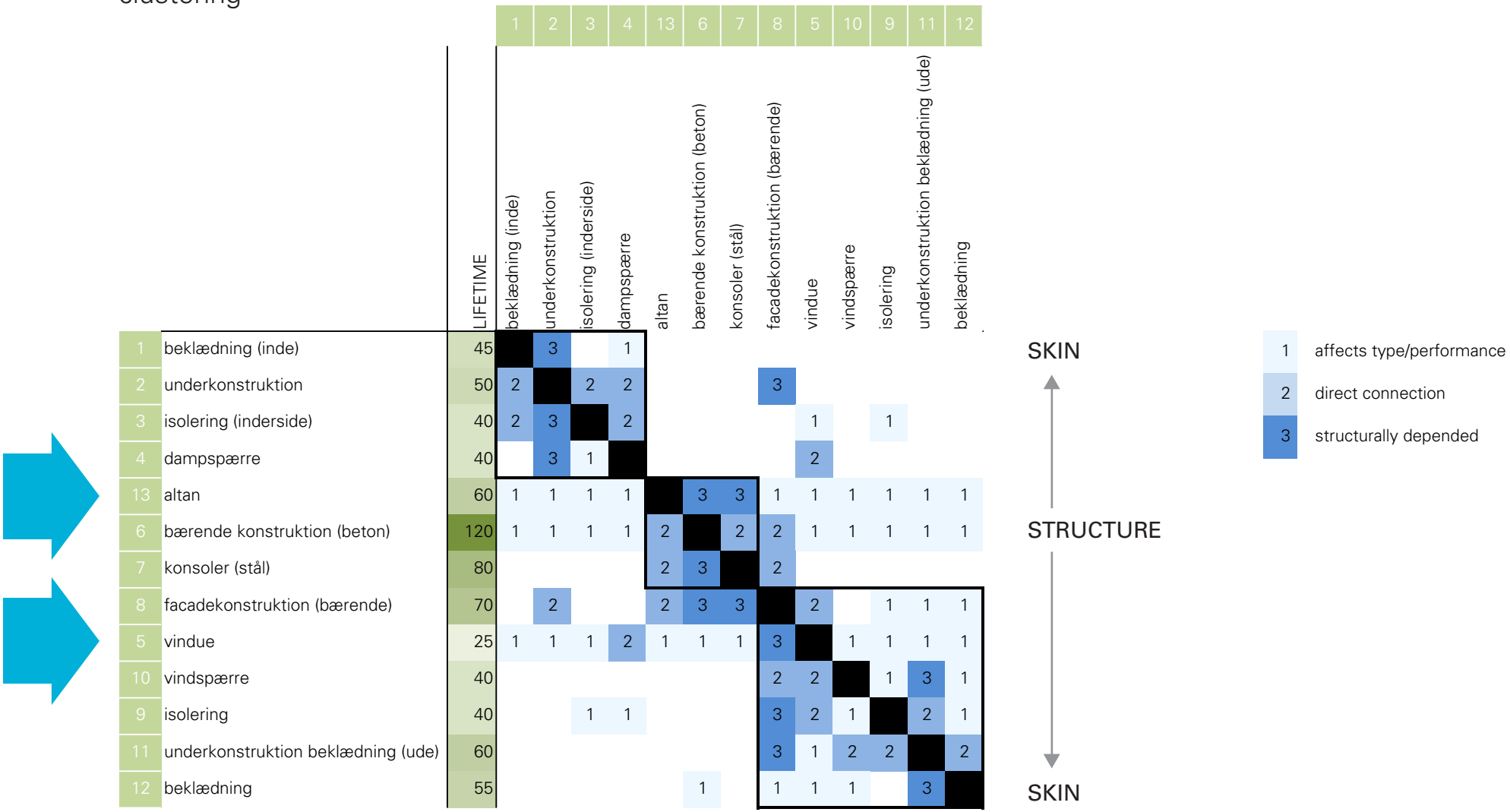
Jan Schipull Kauschen
Architect MAA, Dipl.-Ing. (Arch)
CINARK - Centre for Industrialised Architecture + JJW arkitekter, Copenhagen

jan.kauschen@kadk.dk
www.cinark.dk

The Royal Danish Academy of Fine Arts
Schools of Architecture, Design and Conservation
School of Architecture

Sustainable Innovation 2012 / Alanus University, Bonn / 2012.10.30

Design Structure Matrix (DSM) - clustering



Life Cycle Thinking and Integrated Product Deliveries in renovation projects:
Extending the concept of Integrated Product Deliveries with Product Service Systems

Jan Schipull Kauschen // CINARK+JJW

Choice of materials and environmental impacts

facade with standard insulation material (U-Value: 0,16W/m2K)

facade with environmentally favourable materials (U-Value: 0,16W/m2K)

weighted results for a 20 year life cycle (DGNB weighting):

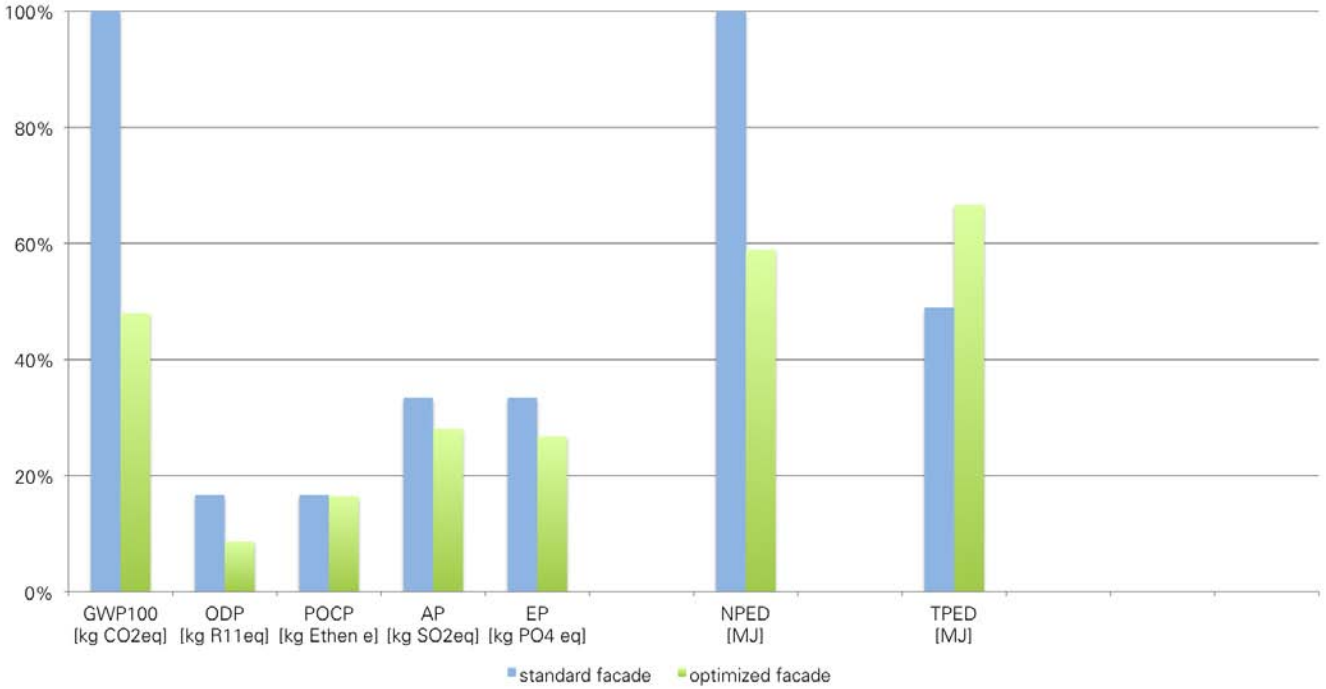
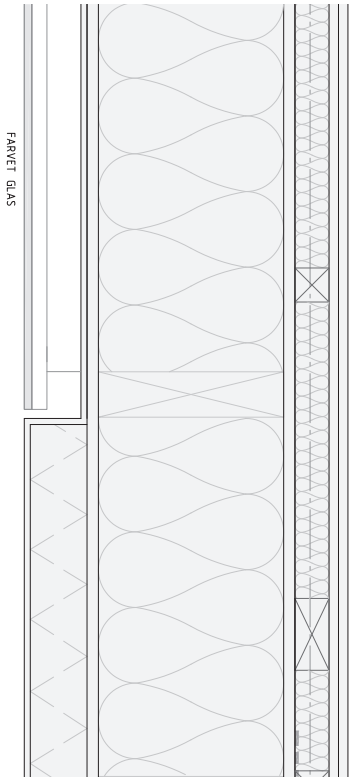


Chart 1a: Comparison of environmental impacts for standard and optimized materials over a 20 year life cycle, weighted results

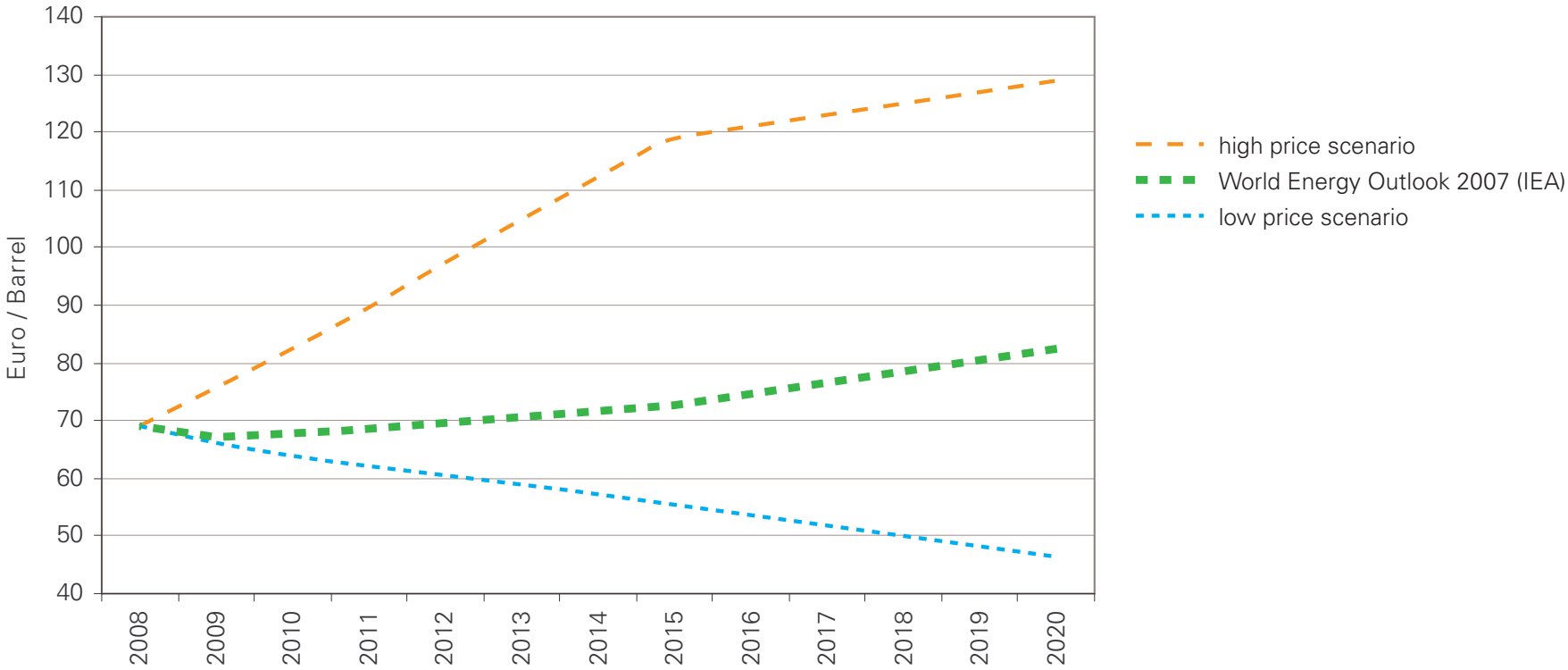
mineral wool 40-160 kr/m2



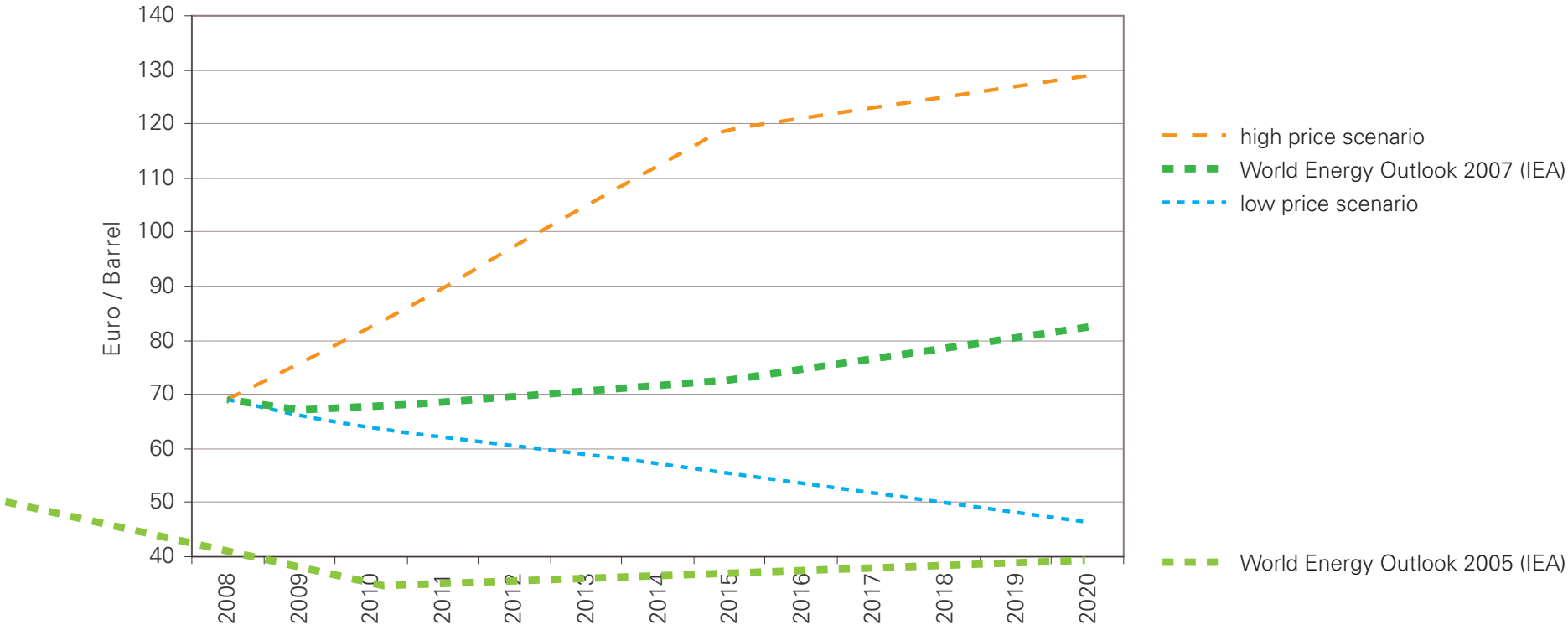
wood fibre insulation 75-200 kr/m2

-30% **+25%**

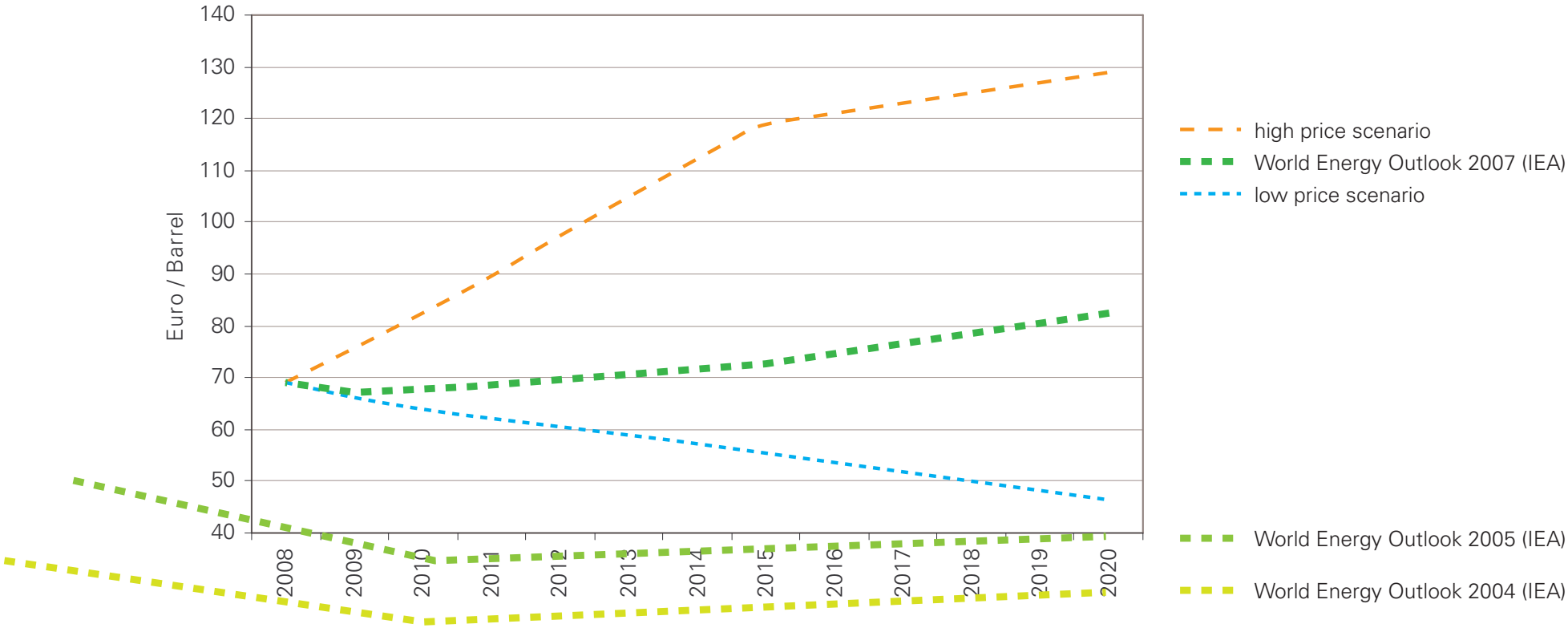
Oil price development scenarios



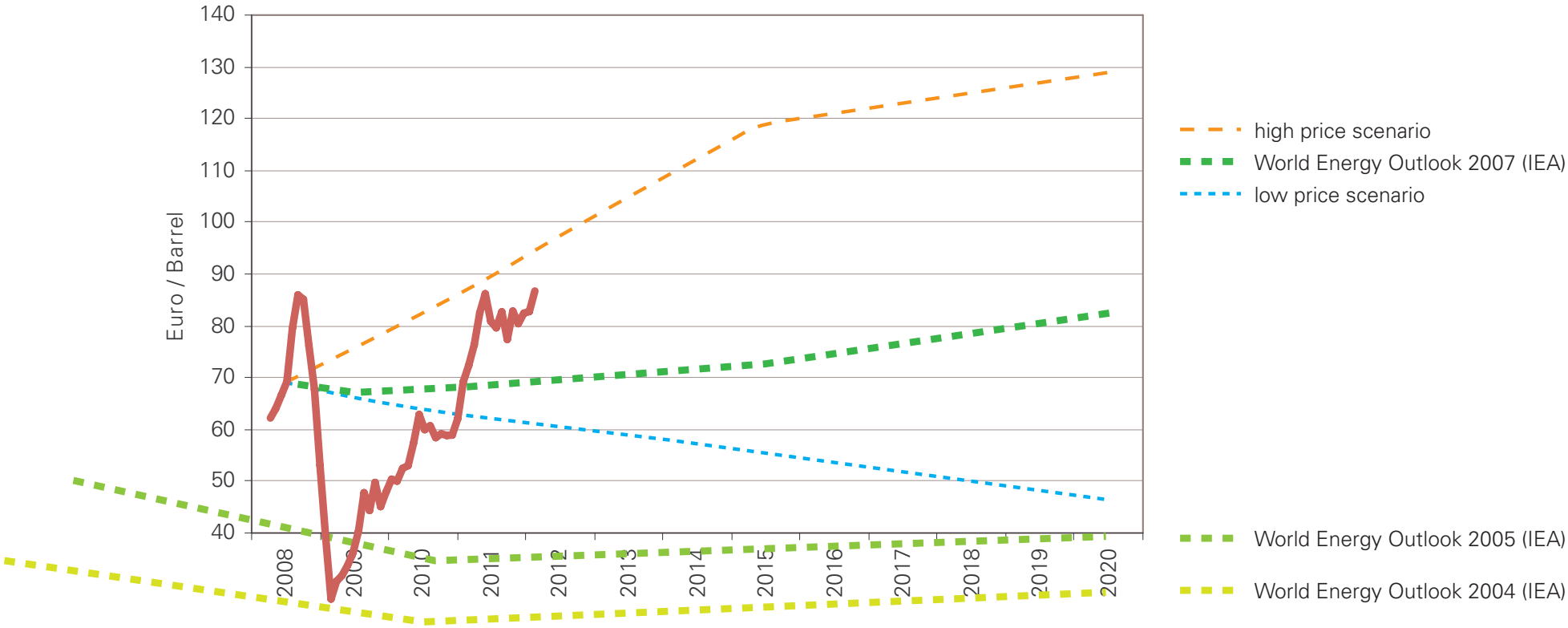
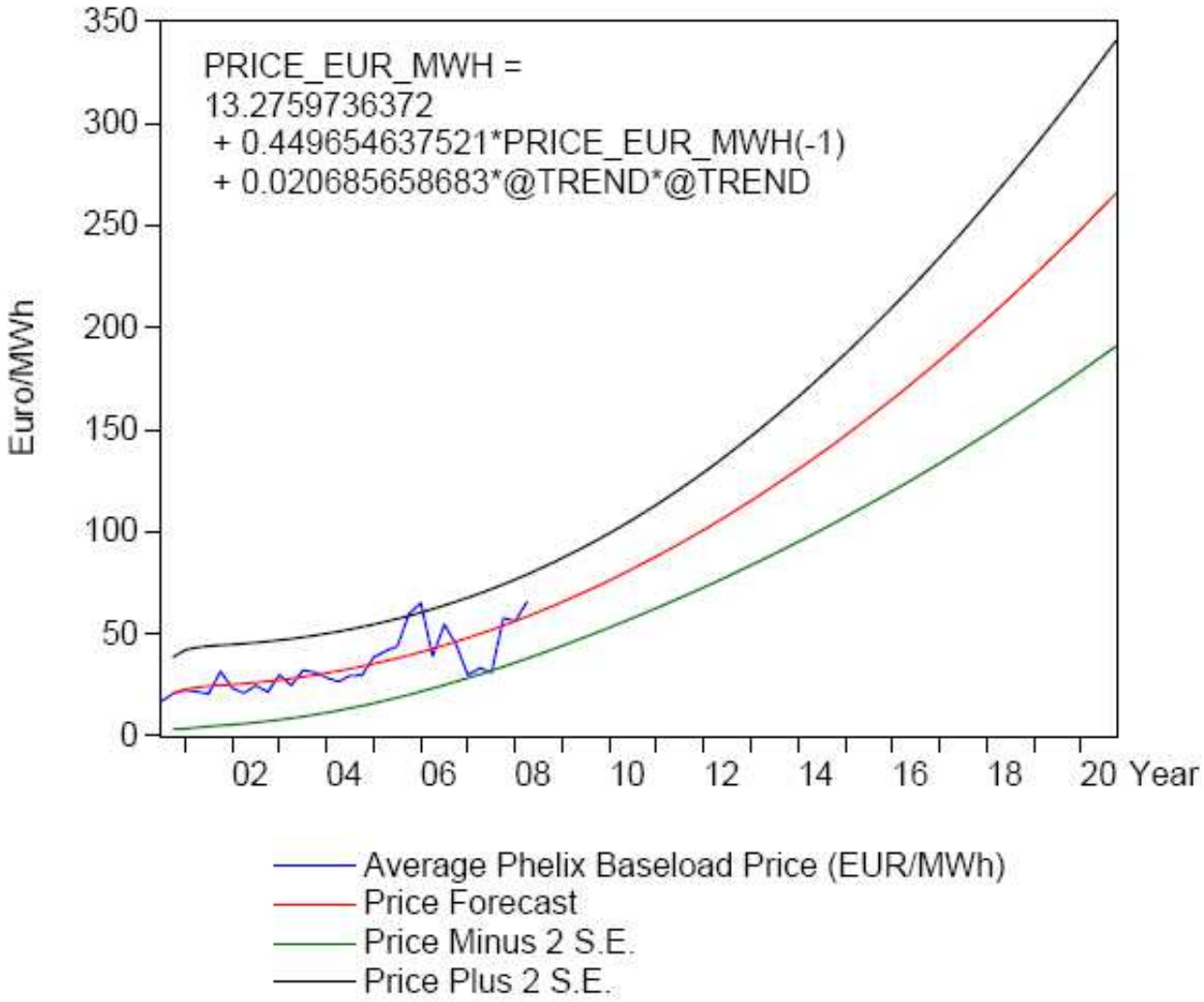
Oil price development scenarios



Oil price development scenarios



Oil price development scenarios



Electricity price development scenarios