

Smart buildings need intelligent design

Peter Andreas Sattrup

Architect MAA PhD Senior Adviser

**Danish Association of
Architectural Firms**

References

Koolhaas Venice

EnergyLab Nordhavn – nye energiinfrastrukturer i byer

CCO DTU

AART Bolig for livet – house for life

The Zebra

HLA case – Reduce Optimize Produce

Ventilation stats 24%

B&E office

Snøhetta Harvard

Meet my colleagues: Paul, Sait, Karen, Klaus & Ulla



Peter Andreas Sattrup Architect MAA PhD Senior Adviser

Images:Kotraframe

TRANSFORM - Industriens Hus



Schönherr – Industriens Hus



TRANSFORM – Industriens Hus



Peter Andreas Sattrup Architect MAA PhD Senior Adviser

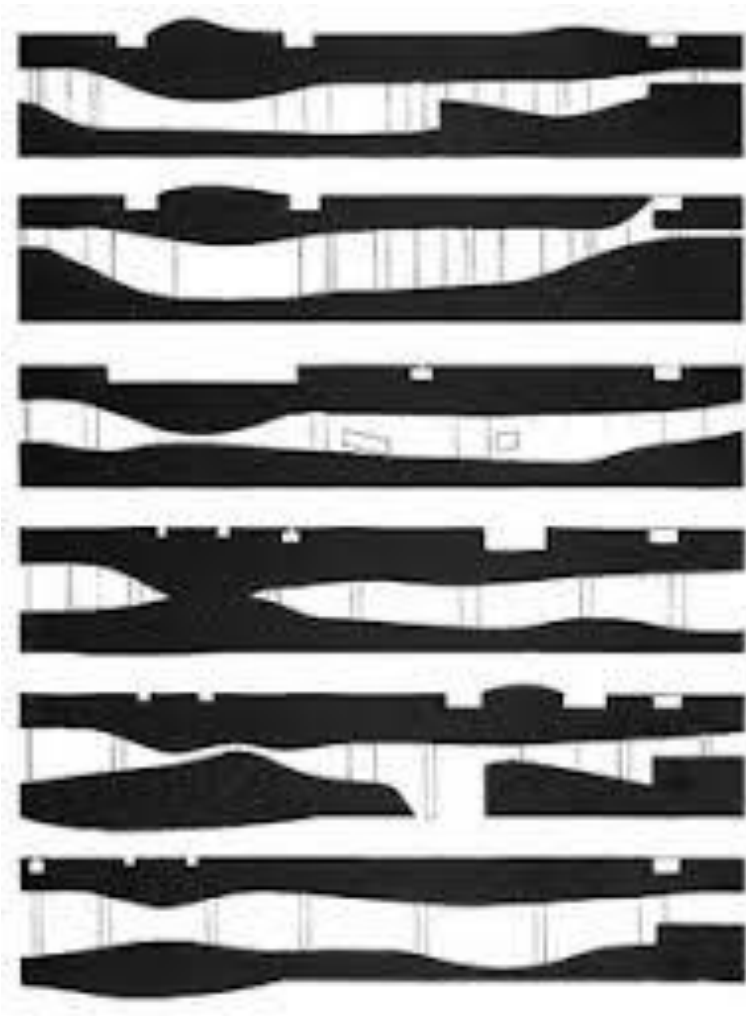
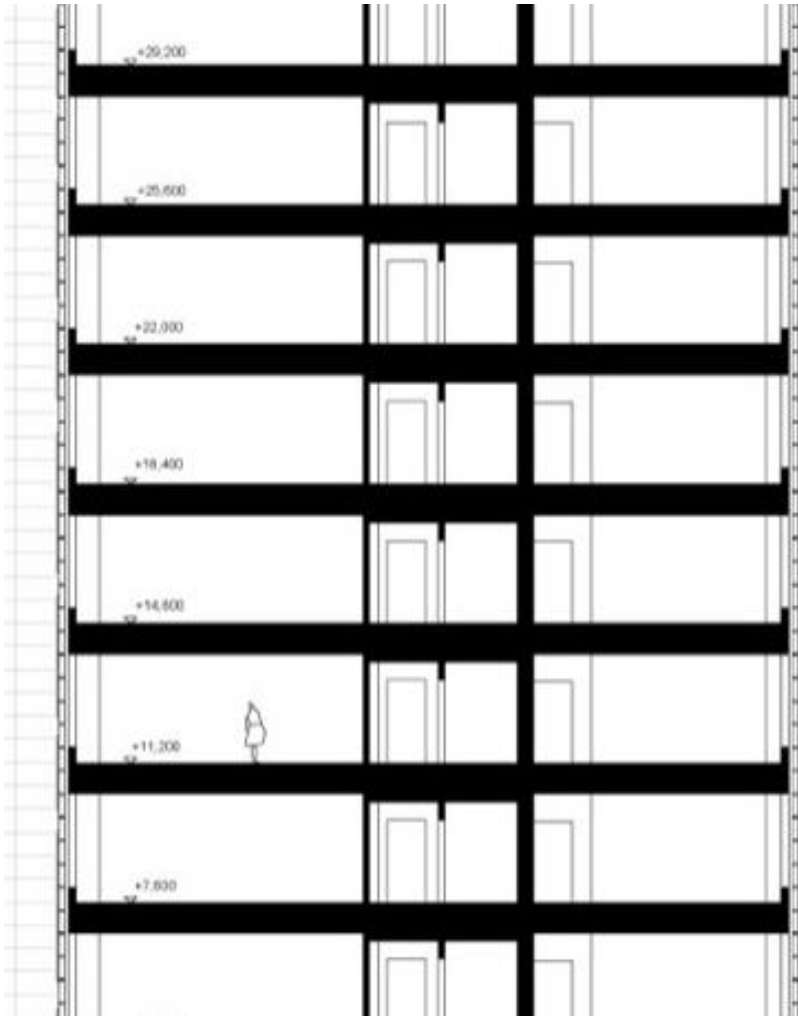
Images:Kotrafame

OMA / Rem Koolhaas - Elements



Images: ArchDaily, OMA

OMA / Rem Koolhaas - "The Zebra"



Images: ArchDaily, OMA

Baumschlager Eberle - 2226



Images: ArchDaily, OMA

Henning Larsen Architects – Kolding Campus



Images: ArchDaily, OMA

Henning Larsen Architects – Kolding Campus

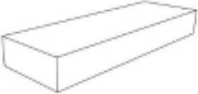


Images: ArchDaily, OMA

Henning Larsen Architects – Kolding Campus

REFERENCE: 95 kWh/m²/year

The project is based on the standards for traditional building as provided for in Danish building regulations BR08. This corresponds to an energy consumption of 95 kWh/m²/year. The objective for the project is to meet the 2015 energy requirements of Danish building regulations, corresponding to approx. 42 kWh/m²/year.



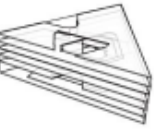


REDUCE: 95 kWh/m²/year → 88.8 kWh/m²/year

Context
The new campus building in the centre of Kolding is located by the river and close to the harbour. Situated adjacent to Kolding Design School and International Business College Kolding, the new Kolding Campus will become part of a dynamic study environment.

Orientation and position
Kolding Campus is located in the north-east corner of the site. The rotated position of the building creates a sunny central plaza between the campus and the river and prevents a direct north-facing facade with no sunlight.

Geometry
The triangular shape of the building ensures an optimal use of square metres. The large, rotated atrium provides the building with both ample daylight and a view to all world corners. At the same time, the atrium provides supplementary natural ventilation and night cooling.

Produce

Daylight
Achieving the right amount of daylight in a building is a balancing act between use of large, open windows and shielded windows. The orientation and design of the skylight protect the interior from direct sunlight – as too much light can have a negative impact in the form of increased cooling and ventilation requirements. The atrium provides optimal daylight conditions in the building.

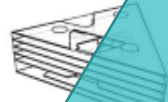



Functional layout
Kolding Campus offers a good, differentiated learning environment with different indoor air quality zones. The building has two climate zones. Teaching and administration facilities are situated in the zone closest to the facade, which has a stable indoor air quality. The atrium has a more fluctuating indoor air quality – allowing the users to sense the changing seasons.

Optimize

Dynamic facade
The facade is a dynamic, mobile solar collector. It consists of a light structure of movable, triangular elements, which regulate the daylight intake, as well as a heavier, well-insulated structure. The opening angle of the facade is approx. 50%.

Reduce

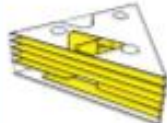
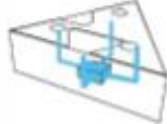
Heavy structures
Kolding Campus is part of a development project (cf. page 135) which examines how the thermal properties of concrete can be increased – and the energy consumption reduced. In order to make use of the thermal properties of concrete, the structure is made as heavy as possible. This prevents large temperature fluctuations and improves the indoor air quality.

OPTIMISE: 88.8 kWh/m²/year → 52.5 kWh/m²/year

Lighting
Kolding Campus features needs-based lighting. Energy-efficient LED lighting has been applied in the entire building.

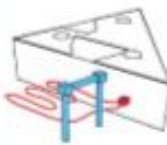

Mechanical ventilation
A mechanical, needs-based MV (Variable Air Volume) ventilation system with high efficiency has been included in the building. The system works together with the thermo-active structures. Vapour-permeable ceilings ensure a low pressure loss and reduce the amount of pipes and fittings.

PRODUCE: 52.5 kWh/m²/year → 38.4 kWh/m²/year

Agile Thermal Energy Storage (ATES)
Kolding Campus features a combined heating and cooling pumping system, which uses groundwater to regulate the building temperature. The fully integrated system works together with the other building installations, which for instance apply the outside air for cooling.

Solar cell system
A solar cell system on the roof produces electricity.



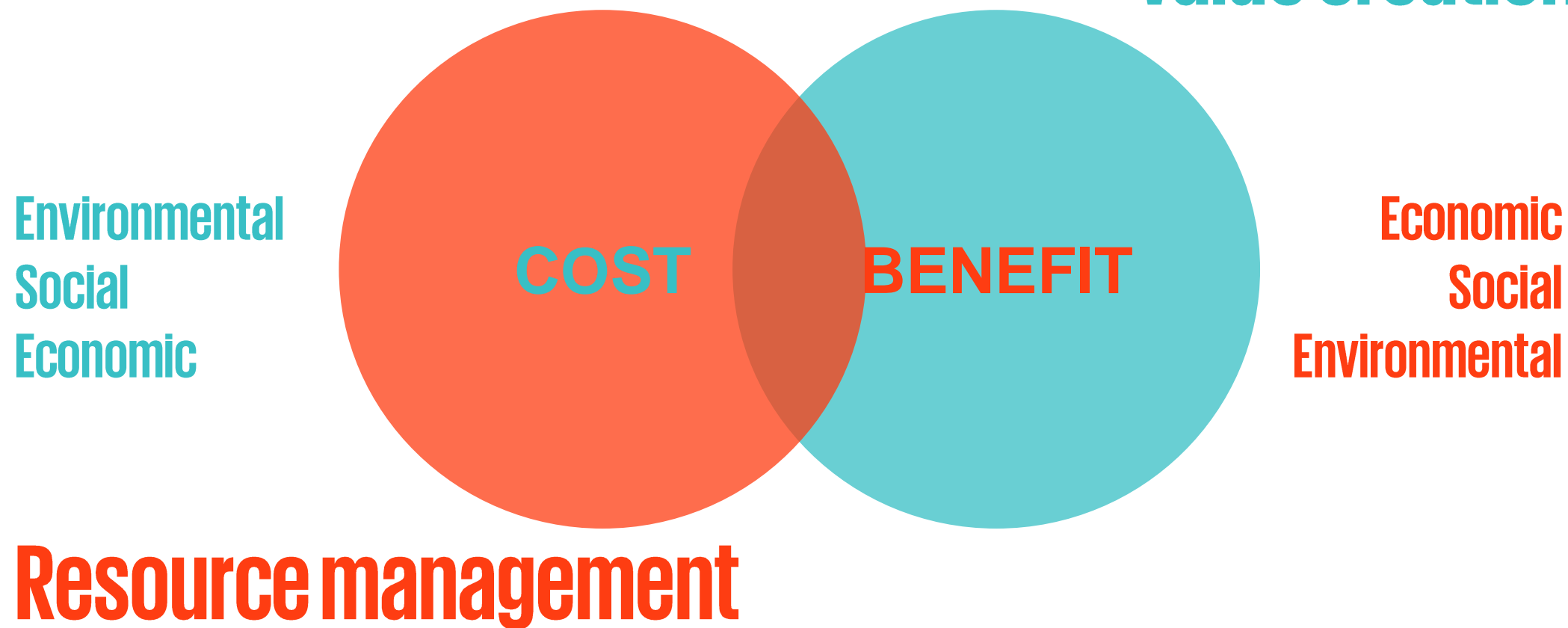
CASE: Rambøll Hq – Mikkelsen arkitekter

Climate, resources urban life, economy

“There’s focus on sustainability and reduced energy use – but also on the daily operation and how the building stimulates collaboration across departments and disciplines”

– Lars Ostenfeld Riemann, Client

Value creation



CASE: Jaegers Let Hal - Vandkunsten



Photo by Mads Frederik

Peter Andreas Sattrup Architect MAA PhD Senior Adviser

CASE: Jaegers Let Hal – Vandkunsten



CASE: DTU Mathematics – Christensen & Co



CASE: Rymsgade 30 – Krydsrum arkitekter



CASE: Up-cycle house – Lendager Group



CASE: VUC Haderslev – AART architects



Photo by Jens Markus Lindhe

CASE: VUC Haderslev – AART architects

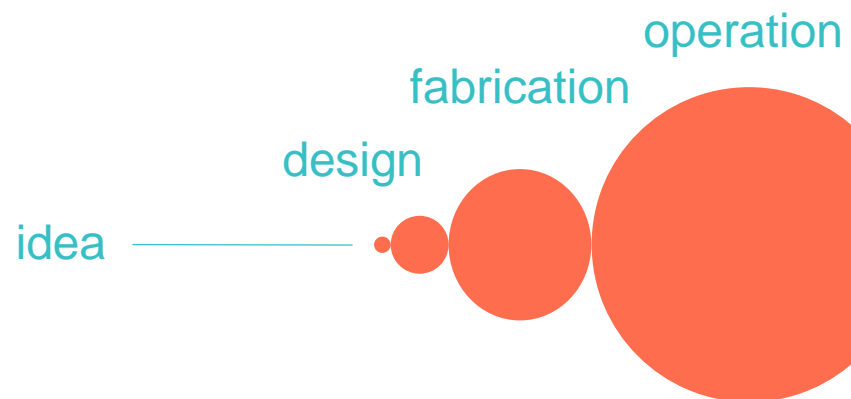
Productivity & learning, urban liveability

Students and teachers very satisfied with study environment

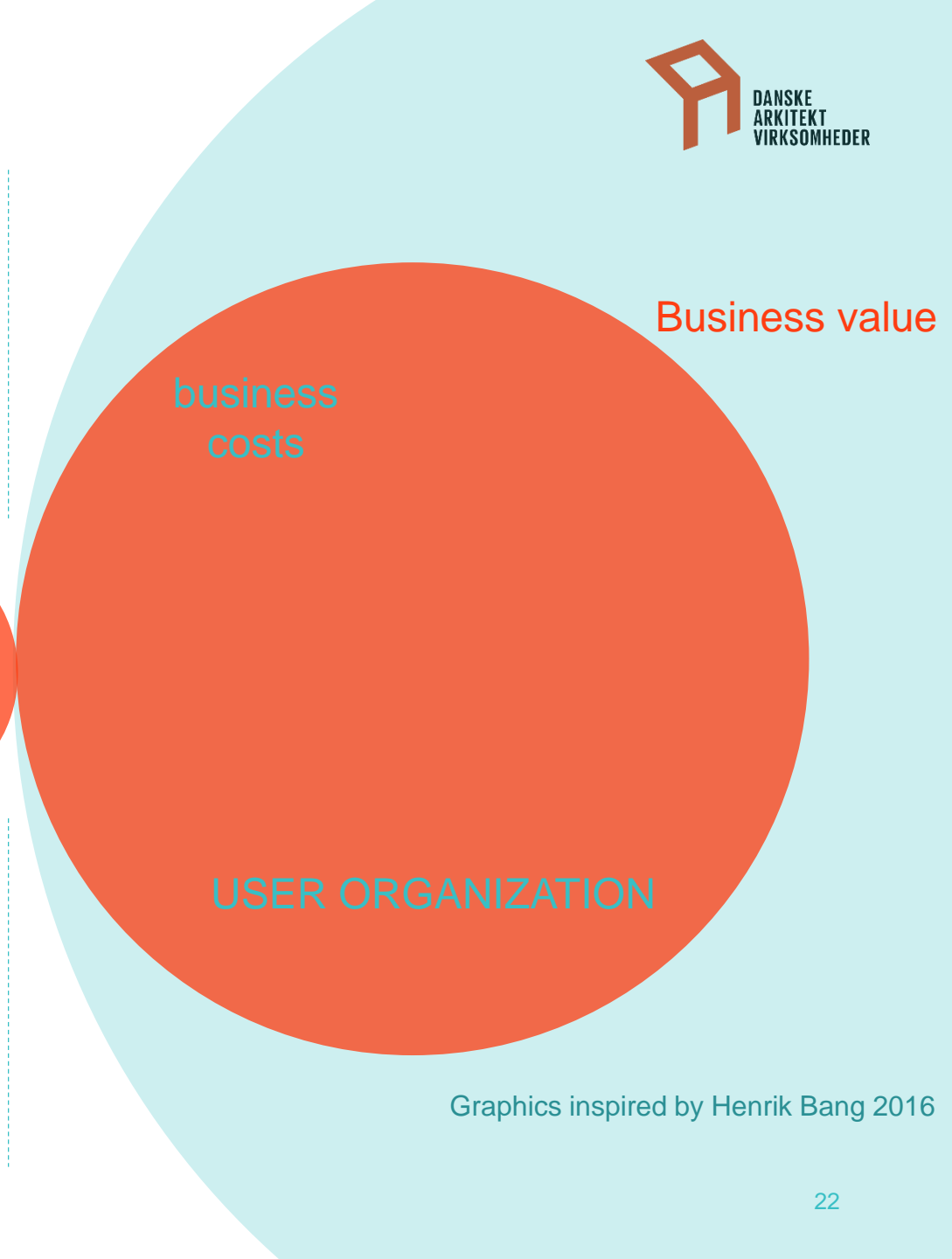
2x students continue to further education

- Building paid back in 3 years?

Value



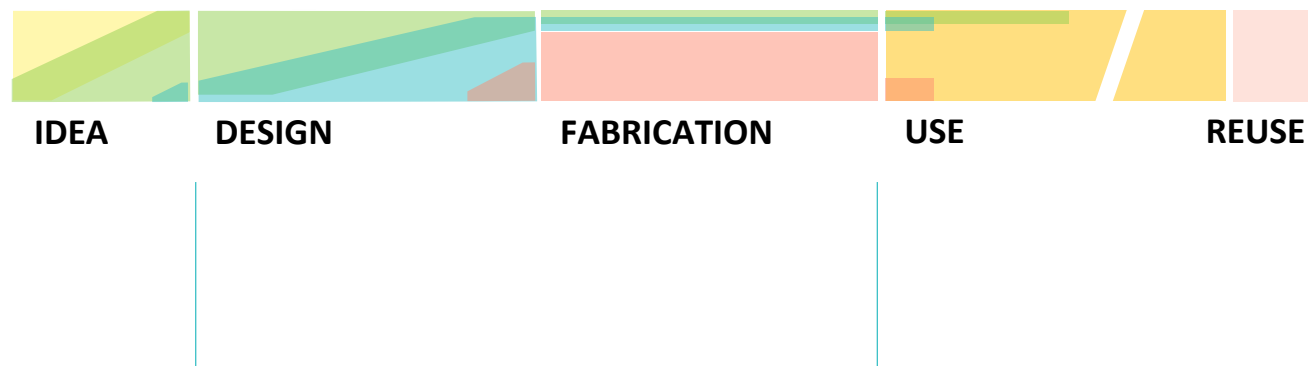
BUILT
ENVIRONMENT



Cost

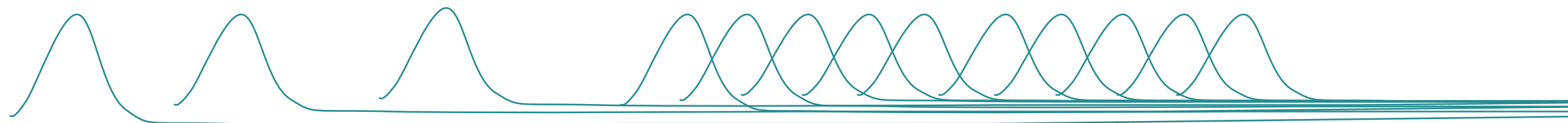
Graphics inspired by Henrik Bang 2016

PERSPECTIVES: TOOLS and METHODS



BEFORE DURING

AFTER



KPIs

PERFORMANCE ESTIMATES

PERFORMANCE MONITORING

PERSPECTIVES: TOOLS and METHODS

ENVIRONMENT

Indeklima Bymiljø
Bokvalitet Arbejdsmiljø
Friareal Naturindvinding

Simulations
Measurements
Life Cycle Assessment

Resource forbrug
Cirkulær økonomi
Miljøforskninger – CO2

SOCIAL

Trivsel, Sundhed
Produktivitet, Læring
Sammenhængskraft Byliv

Dialogue processes
Co-creation
User evaluations

Kerfærde Arbejdsulykker
Social ansvarlighed
Gentrifisering, ulighed

ECONOMY

Samfundsøkonomi
Investeringssikkerhed
Afledte økonomiske effekter

Financing
Business Models
Life Cycle Cost

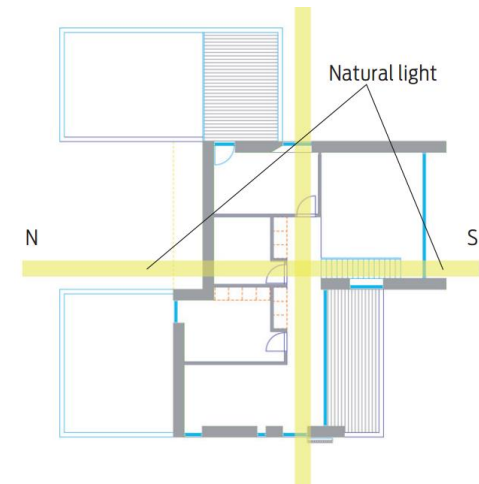
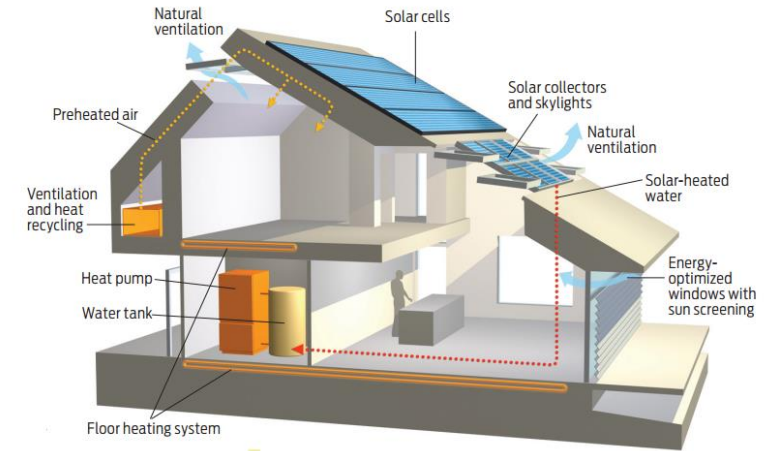
Arbejdsøkonomi
Transition omkostninger
Totaløkonomi

AART – Bolig for Livet



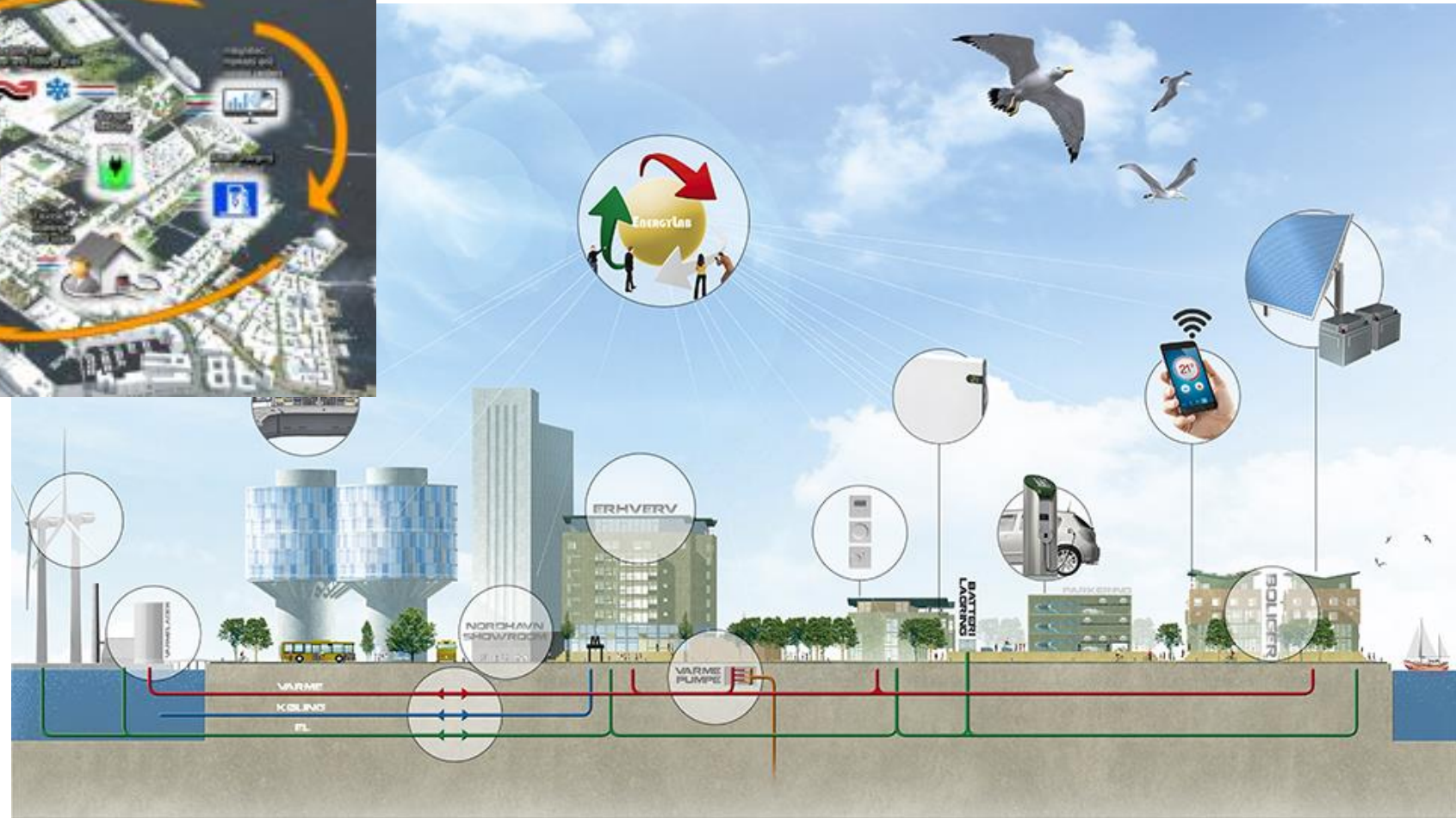
Images: ArchDaily, OMA

AART – Bolig for Livet



Images: AART, Velux

Nordhavn - EnergyLab



Images: AART, Velux

Silos – COBE & Praksis



Images: AART, Velux

Copenhagen International School – CF Møller



Images: AART, Velux

More cases & background information:

www.danskeark.dk

Peter Andreas Sattrup, Nanna Rose Broch, Karen Sejr, Cathrine Filia Trakossas, Mia Winther-Queen

Advisory board: Mette Skjold, Torben Juul & Søren Nielsen.

Thanks to all the architectural firms and their collaboration partners who contributed!

Danske Arkitektvirksomheder – Danish Association of Architectural Firms 2017