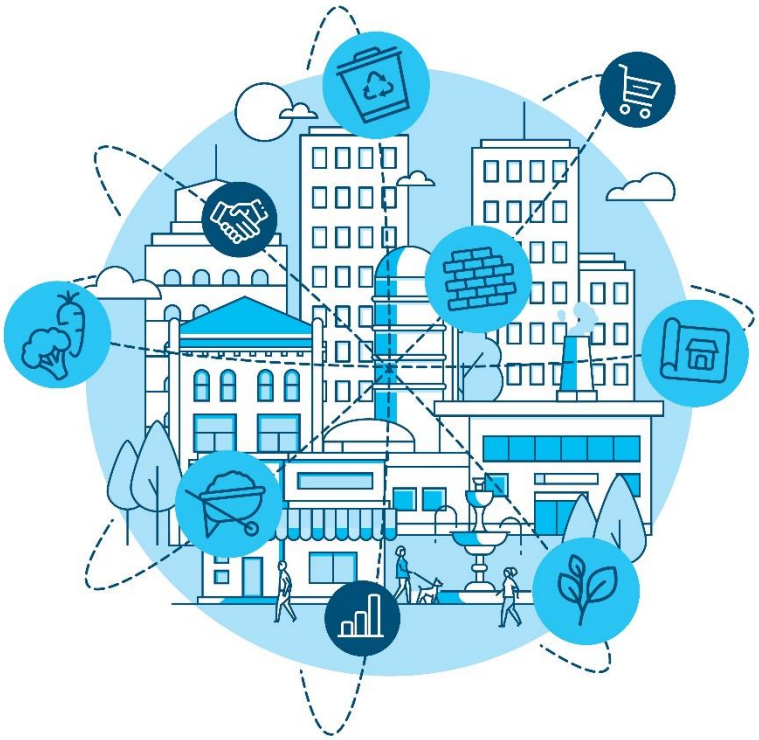
Business case in Høje-Taastrup

Description

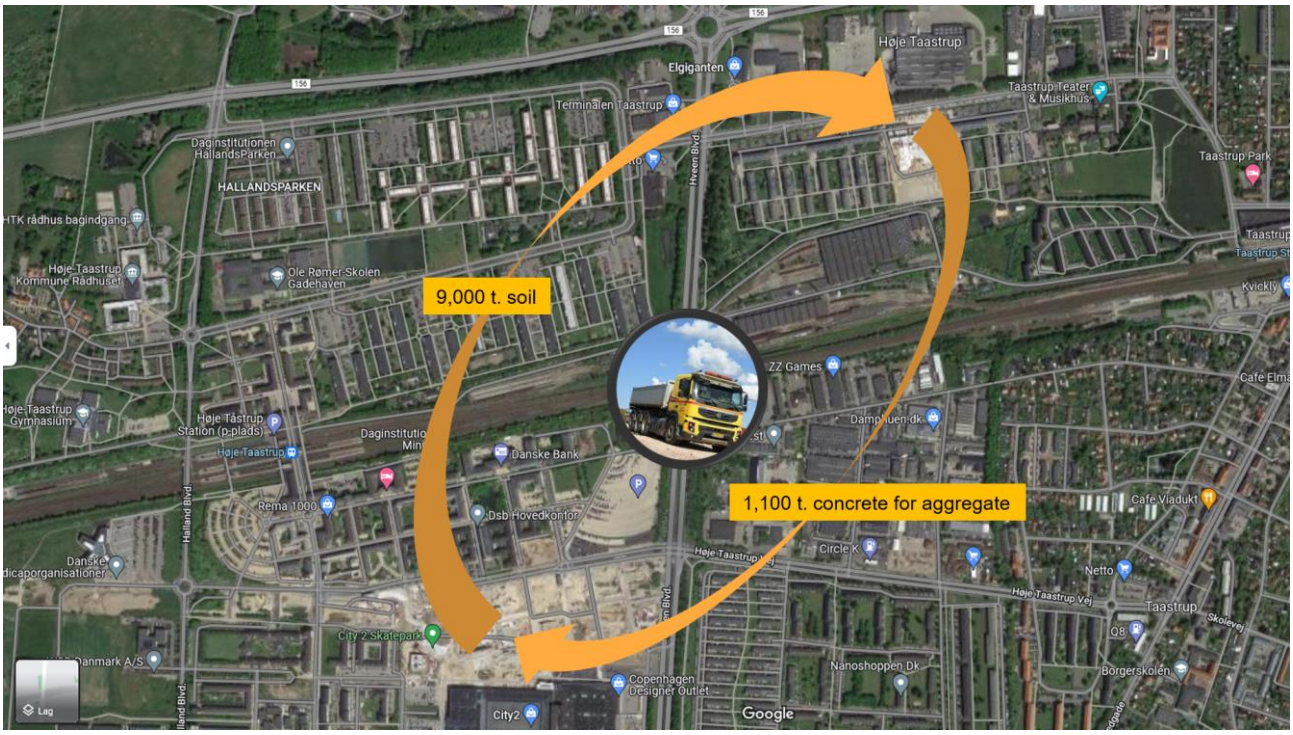
Municipality of Høje-Taastrup and Danish Association of Construction Clients, Denmark



Contents

This text describes Høje-Taastrup's business case in the construction of the new City Hall, by reusing crushed concrete, and the demolition of Taastrupgaard housing blocks, by reusing excavated soil. The sections come from Høje-Taastrup's CityLoops demonstration report available here.

Business cases – Høje-Taastrup



National market conditions

The circular economy in the Danish building sector is growing, and some influencing regulation is on its way. The national regulation concerns primarily material (waste) flows to increase the transparency of CDW flows (soil are regulated already) and includes among other resource mapping (added to the already applicable environmental mapping) and demolition plan both connected to selective demolition. The new national regulation is expected to be implemented during 2023.

One of the issues regarding growing the circular market for secondary materials and product is the lack of end-of-waste criteria, which for the moment is individually and locally handled by the municipalities without a clear national consensus. It seems that the authorities are waiting for two EU-related initiatives; common end-of-waste criteria and the revision of the construction product regulation as secondary products and materials are expected to be included in this regulation. In addition, CE and/or ETA regulation must be taken into consideration.

However, the market actors including demolition and waste handling companies, consultants and clients are innovating and experimenting on demonstration level to get useful experiences for the future market. Few compagnies have succeeded with a full value / block chain implementation of upcycled CDW e.g., A:GAIN [Link] who upcycles e.g. fixtures as furniture, panels etc., NÆSTE (NEXT) [Link] who creates and deliver sheds made of recycled

construction wood, STARK/GENTRÆ [Link] who recycles construction site wood and Fischer Lighting [Link] who collects lamps and light fixtures and upgraded them with new technology for B2B resale.

Some Danish contractors and concrete suppliers are also capable to handle crushed concrete and/or elements as reused material in new constructions including screening, sampling, testing, (perhaps) temporary storing and mixing into approved recipes. Furthermore, there are several companies who are capable of handling and reusing excavated soil, gravel, and sand for new, typically landscape purposes.

Handling of both excavated soil and CDW are generally liberalized in Denmark. Depots must be approved by the authorities which includes temporary depots at waste handling companies, but handling of waste for energy production (e.g., construction wood) are mainly driven by public owned facilities. The liberalization of the last mentioned is however under negotiation for the moment.

There are no current plans for regulation of the circular market though it could speed up the adjustment process with e.g., taxes or other incentive stimulating elements. Politically it seems to be the attitude that the market should developed itself within consideration of access to resources and the prize development on both primary and secondary materials. However, there will be some obstructions regarding another aspects of sustainability as several analysis concludes that the number of demolished buildings should be decreased and that can affect the access to secondary resources.

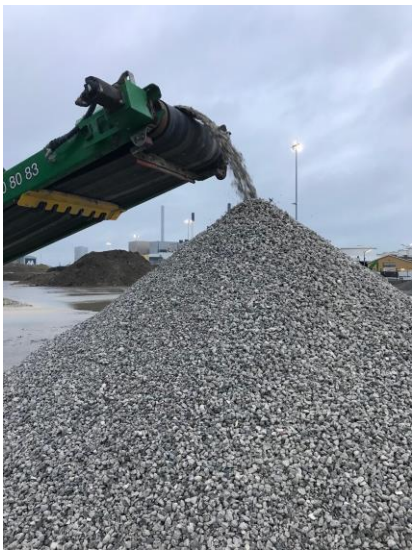
Business case #1 - New City Hall (reuse of crushed concrete)

In brief

The value chain – involved actors.

- 1.100-ton demolished concrete has been 100 pct. reused as aggregate in the foundation of the new City Hall. The rest of the building was made of prefabricated, new concrete from a long distant producer.
- In the calculation, the environmental consultant (Wissenberg) estimated approx. 15 € excl. tax per ton including disposal and transport (approx. 25 km) as the actual savings.

- The demolition company (Søndergaard) has sold (handed over) the demolished concrete to the CDW deposit and handling company (Norrecco) for the price of 0 €.
- The handling and production cost of recycled aggregate has roughly been around (net) 25 € excl. tax per ton, and the final (exit) price (from Unicon) is estimated to 200 € excl. tax per ton. The market price for new concrete to foundation including production, test and transport is estimated to 200-250 € per ton.
- As the aggregate in the foundation concrete has been 100 pct. recycled aggregate, it is possible to compare between the used concrete with recycled aggregate with new concrete with virgin aggregates. The concrete supplier (Unicon) states that the exit/market price of recycled aggregate has been a bit higher than the new aggregate, but not higher than the difference could be absorbed in the overhead.
- The contractor (CASA) who bought the concrete with recycled aggregates states that the added cost compared to new concrete primarily is caused by more testing and consultancy (by Pelcon). This cost has partly paid by the CityLoops project.
- The client and future owner of the City Hall has paid same price as if it has been used 100 pct. new concrete.



The photos show the process from demolition in Taastrupgaard to reuse of crushed concrete in the foundation of the new City Hall in Høje-Taastrup

Facts and details

Revenues	€ per ton
Entry price (AKB > Søndergaard)*	0
Handling and transport to handling to Norrecco (crushing on-site was not an option)	15
Handling, testing, production and storing of recycled aggregate at Norreco (agreed price)	25
Production, testing and deliverance of concrete with partly recycled concrete from Unicon	200
Market price - new concrete for foundation with virgin aggregates	250

**Demolition costs are not included in the calculation as it was meant to be done anyway.*

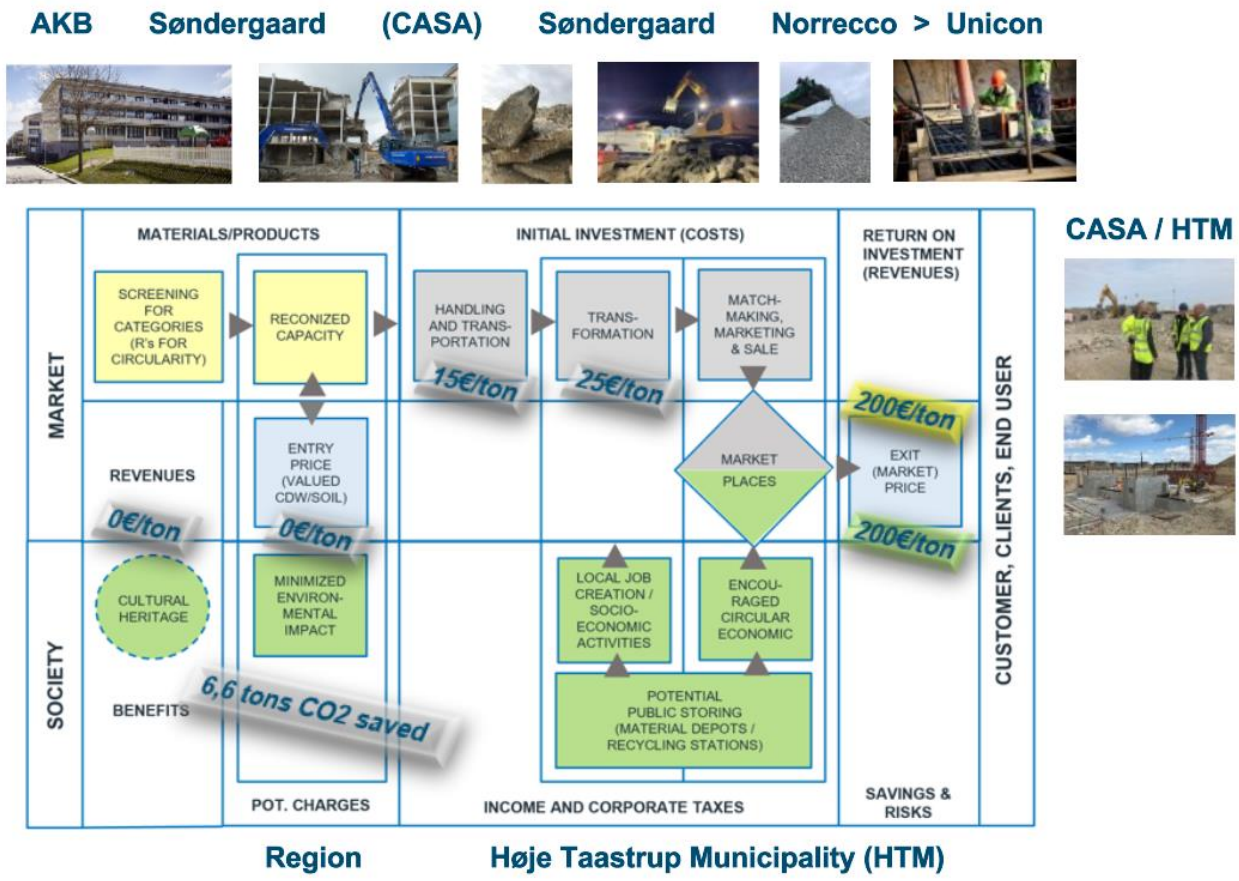


Fig. 1: Model used for overviewing and evaluation of the business case[1].

[1] https://bygherreforeningen.dk/download/13/filarkiv/51142/cityloops_circular_construction_business_case_model_final-1.pdf

Benefits

- Less use of virgin raw material as aggregate / recycling locally in the municipality / region.
- Utilization of recycled concrete in higher value than road fill.
- 6,6 tons of carbon has been saved by less transport.
- Material storage has been limited to two months (Norreco).
- Demonstration effect and experiences has been achieved (Mayor of Architecture 2022).
- Increased attention on circular economy – locally and broader during conferences, Market readiness, inspiration etc.

Business case #2 - Taastrupgaard (reuse of excavated soil)

In brief

There has been moved 9.000 ton of uncontaminated soil from the excavation of the cellar and foundation at the new City Hall to the landscape around the children's and cultural house in Taastrupgaard.

The soil had to be intermediated landfilled (close to the City Hall site for two weeks before Taastrupgaard was ready for receiving the soil on site.

The distance between the two sites / locations is approx. 3 km. The estimated alternative was depositing the soil at land recipients around 25 km away from the City Hall site (based on average distance deposits).

In the same way excavated soil to the Tastrupgaard site was expected coming from as least 25 km away if the new City Hall has not been built.

The construction site at the new City Hall I Høje-Taastrup from where excavated soil was transported 3 km away and reused under a football field (see next page)

The excavated soil from the construction of the new City Hall I Høje-Taastrup is reused under this football field 3 km away.

Facts and details

- 9,000 ton of uncontaminated soil from the excavation of the cellar and foundation at the new City Hall have been moved to the landscape around the children's and cultural house in Taastrupgård.
- The soil had to be intermediated landfilled (close to the City Hall site in two weeks before Taastrupgård was ready for receiving the soil on site.
- The distance between the two sites / locations is approx. 3 km. The estimated alternative was depositing the soil at land recipients around 25 km away from the City Hall site (based on actual open deposits).
- In the same way excavated soil to the Taastrupgård site was expected coming from as least 25 km away if the new City Hall has not been built.
- So, 9,000 ton of soil has been transported 3 km instead of (2x25) = 50 km. In addition, there has been a number of dumper truck hours at the intermediate landfill.

The amount of CO2 emission is calculated as:

Comments		
Cells marked in light blue, should be filled. All distances are calculated from site where soil is excavated.	Distance to end deposite, km	50
	Distance to local reuse, km	3
	Amount of soil, tons	9000
	Reuse percentage	100
	Use of wheel loader, hours	15
	Use of heavy dumper, hours	15
CO2-emissions soil transport per tonne kilometre	Soil transport, kg CO2/tonkm	0,081
CO2-emissions crushing per tonne material, diesel	Wheel loader, kg CO2/hour	25,68
CO2-emissions screening per tonne material, diesel	Dumper, kg CO2/hour	37,54
CO2-emissions full trailer combination, two way transport	Transport of loader and dumper kg CO2	135,13

CO_2 saving potential		
Soil transport	**Project CO2 spend**	**Reference**
Transport to end deposite, kg CO2	0	36.586
Transport to site for reuse, kg CO2	2.195	
Use of wheel loader	385	
Use of heavy dumper	563	
Transport of loader and dumper	135	
Sum	3.279	36.586

Kg CO_2 saving potential total	**33.308**

The price for transport and disposal of excavated soil is estimated to be between 15-25 € per ton excl. taxes (the exact price in this specific case is unknown), the price per hour for a wheel loader / a dumper is estimated at 500 € incl. driver, and for the moment a tax price of 100 € per ton CO2 is negotiated in the industry.

The calculation can be presented as:

Conventional handling

Entry price	0€
Transport and disposal of the soil in deposit in 25 km distance (20 x 9,000)	180,000 €
CO2 tax (100 x 36,6)	3,600 €
Total	183,300 €

Recycling of the soil

Entry price	0 €
Intermediate landfill and transport of the soil in 3 km distance (3 x 9,000)	27,000 €
Wheel loader and dumper (30 hours x 500)	15,000 €
	42,000 €
Saved CO2 tax (100 x 3,3) =	- 330 €
Total	41,670 €
Difference in favour of the client	**138,630 €**

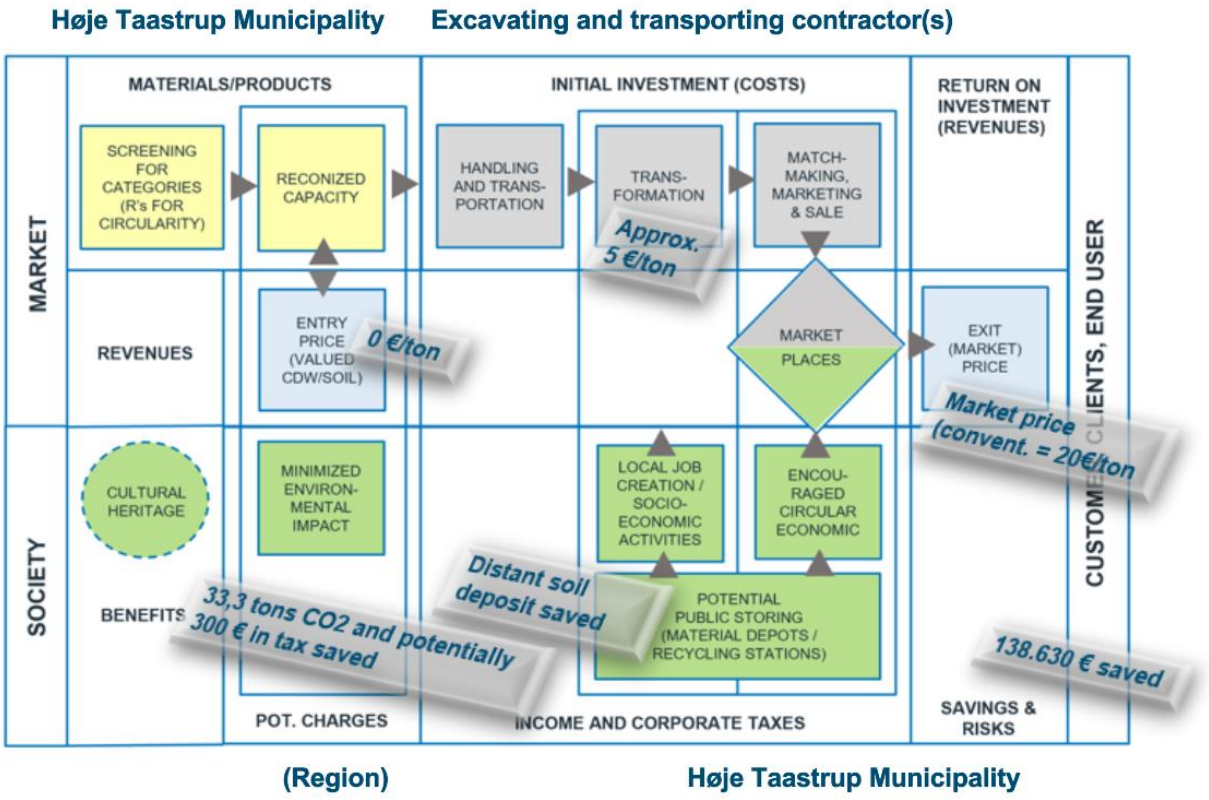


Fig. 2: Model used for overviewing and evaluation of the business case[2].

Lessons learned and replication opportunities

The two cases descripted above are directly connected and has given the municipality as client to opportunity to optimize them both, even if it has not been the same carrying out companies who were involved.

The evaluation of the project as a whole and the business cases in particular shows,

- That stakeholder engagement and willingness to collaborate among the involved stakeholders is a necessary precondition in an immature circular market where everybody must make their own considerations on a low level of experiences – one part in the value chain can block the process as it was happening in an early phase of the demonstration project, where recycling of crushed concrete into new sidewalk tiles were given up.

[2] https://bygherreforeningen.dk/download/13/filarkiv/51142/cityloops_circular_construction_business_case_model_final-1.pdf

- That “time is money” and time line matching with material deliverance is often essential - in this particular cases it was not possible to store and handle the concrete on site and avoiding preliminary storing of the soil, but the costs related to temporary moving machinery away from the area for a while and transportation of the material over only short distances was affordable, and the client got the demolished concrete or excavated soil for free.
- That establishing clean fractions in one transaction are essential – every transaction or separation in-creases the costs and effects the final price, and finally.
- That potential risks must be identified up front to connect risk and responsibilities between the involved stakeholders unambiguous – insecurity about the responsibility increases the prices to cover potential losses.

Based on the preconditions and experiences above the two cases are immediately replicable. Unfortunately, it has not been possible to explore the commercial part of the two business cases in Høje-Taastrup because of some reluctance to share financial data for competitive reasons.

Therefore, the conclusion of the financial success in both cases is primarily related to the fact that the costs of recycling and re-use of concrete and soil in these cases has not been higher – compared to the market price of new concrete and virgin materials for the same purposes – but gives a market advantage in terms of being able to offer a more sustainable product.

CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and bio-waste, where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkeli (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and soil, and bio-waste, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 821033.