BUILDING VALUE

A pathway to circular construction finance

A report by:

With the support of the Community of Practice:

THE COMMUNITY OF PRACTICE

The transition to a Circular Economy requires innovative business models that stimulate optimised use of repairable products, reusable components and recycling of materials. A Community of Practice (CoP) was established in which experts from different fields collaborated to improve the financeability of circular construction. CoP members engaged in a case of social housing corporation Eigen Haard. This report retraces the 'learning-by-doing' trajectory of this Community of Practice. It provides tools to unlock the potential of circular construction business models.

CIRCULAR CONSTRUCTION

Circular construction requires a different way of looking at both the process and product of construction. When looking at the process, an empty site provides a different starting point from a site with a building that will be dismounted: in designing a circular building, one first reviews what is already there. Reusing elements, products and materials, from the same site or a different location, is prioritized over procuring new ones. When looking at the product, buildings can be seen as a collection of layers[1]: each layer has a different function, subset of elements, products and materials, and lifespan.

TECHNOLOGY-DRIVEN CHANGE

In order to re-use components from previous construction sites, it is essential that a 'market' for these components develops. Existing marketplaces for circular building materials are scarce and fragmented. Transparency of demand and supply is essential (what elements, products and materials become available, when and where), and detailed knowledge of materials, products and construction is required to develop markets and new business models.

Technology can facilitate this transition with (big) data sources and platforms. Given the potentially rapid adoption of new technology, it is key to avoid a narrow focus on short term benefits. Long term factors to create a future-proof economy should be taken into consideration, including privacy, security and transparency.

VALUING CIRCULAR CONSTRUCTION

Exercises to calculate the net present value of climate and energy systems and foundation demonstrate value from circularity in separate layers of a building. Circular construction increases the residual value of elements, products and materials. It makes more sense to look at the value of separate layers, instead of the value of a whole building.

Two ways of appraising real estate are market value and cost price. Distinguishing between land (location) and buildings, and reporting each layer separately on the balance sheet will enable more comprehensive accounting of value in real estate. Ultimately, the value of the layers and resources needed for (de)mounting them should inform the market value of the real estate.

FINANCING CIRCULAR BUILDINGS

The modular nature of circular buildings can be a strength for the financeability of circular construction. The value can be calculated from each building layer. However, the increased value from circularity lies in the future, whereas financing takes place in the present. Refinancing can be a solution when additional investments in circularity are offset by balancing risks and future potential. Security can be found in residual value of elements, products and materials, bespoke labeling of the latter and scoring circulairy, increased flexibility and lifespan extension of circular buildings.

5 KEY LEARNINGS FOR CIRCULAR CONSTRUCTION

- Circular construction is contingent on development of a market for used elements, products and materials, with information about quantity, makeup, quality guarantees, timing and location.
- Unlocking the potential of circular construction requires new valuation methods, distinguishing between land (i.e. location value) and buildings conceiving the building as six individual layers, each with their own lifespan.
- Circular construction can successfully be financed when risks and future potential are balanced. This can be supported by detailed financial modelling and leveraging key strengths of circular buildings as securities.
- Social housing corporations are ideally suited to implement circular economy business models since both favour long-term inclusive value above mere financial profits. Nonetheless, the approach taken in this white paper can also be adapted for commercial real estate.
- Collaboration and transparency support the creation of synergies between different fields of expertise (business, technical, legal, financial), needed to tackle challenges of circular construction business models

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1 - THE COMMUNITY OF PRACTICE

THE CHALLENGE OF CIRCULAR CONSTRUCTION

The construction sector is one of the biggest sinks of raw materials, and therefore critical in the wider transition to a circular economy[2]. Circular construction is about optimising the lifespan and value of building elements, products and materials to increase the likelihood of their continued use post dismantling. Interest in, and enthusiasm for, the topic is growing, but today there are still few fully realised examples of circular construction.

Challenges lie in the fragmentation and lack of collaboration within the construction chain, short-term revenue models, and perceived high costs of failure[3]. Practical and scalable solutions for circular construction require a holistic perspective which can take account of the construction process, value chain and revenue models.

THE COMMUNITY OF PRACTICE: COLLABORATIVE AND TRANSPARENT

A Community of Practice (CoP) was founded on a collaborative and transparent approach, focusing on the financial challenges of circular construction. The participants were:

Circle Economy and Sustainable Finance Lab (initiators and coordinators); Eigen Haard (case provider); DOOR architects (architects of the case), Arup and Arcadis (design and engineering experts), ING (financial experts), NBA and Alfa Accountants (accounting experts), RICS (surveyor experts), Allen & Overy (legal experts), and Madaster (data experts). Moreover, the following informants contributed on specific topics: Buro Loo (design and engineering experts), Re Use Materials and Alba Concepts (market experts), and THE FCTR E (energy as a service experts).

The CoP was co-funded by Nederland Circulair! and the Dutch Ministry of Infrastructure & Water Management.

CoP members pursued a 'learning-by-doing' trajectory to co-create operational, legal and financial solutions to the Fridtjof Nansenhof circular construction project of 67 social housing units, to be built in Amsterdam West. As a social housing corporation, Eigen Haard has a long term, non-profit business model which differs from commercial developers. Eigen Haard aims to oversee the social housing units for a long period of time. This long-term horizon is a good basis for circular business models.

ABOUT THE WHITE PAPER

CoP members collaborated for shared value creation in the circular construction sector. This report collects findings and outcomes from an open learning environment which involved several workshops and thematic deep dives. As an in-depth study, the report provides a reference for building commissioners and real estate developers to pioneer circular construction. Specifically, this report covers the following themes:

- Circular construction, building layers and the hierarchy of Elements, Products and Materials (EPMs) (Chapter 2);
- The role of gathering, storing and exchanging data for a technology driven change towards a circular construction sector (Chapter 3);
- The need for adjusting valuing methods to reflect circularity (Chapter 4);
- Financing structures that can be used to address risks and future potential of circular investment decisions (Chapter 5); and
- Key learnings for accelerating the circular construction sector (Chapter 6).

> **If a small extra investment results in increased flexibility of the building in the long-term, then it is a smart investment. This long-term investment vision could be further incentivised if financiers make circular construction an investment criterium.**
>
> **Dries Wijte**
> Manager Back Office Finance, Eigen Haard

CASE INTRODUCTION FRIDTJOF NANSENHOF

Eigen Haard is a Dutch housing corporation that primarily develops and rents out social housing. They are responsible for developing and operating social housing projects and aim to integrate a circulair approach. Eigen Haard will redevelop Fridtjof Nansenhof; a residential building complex that will be taken down and re-built in a circular way. The project is currently at the design stage for a new building. The aim is to redevelop 50 (current) housing units in Amsterdam West into 67 (new) 'circular' housing units, with construction due to begin in 2020. This CoP primarily serves as a conceptual reference point to guide decisions on the final design of Fridtjof Nansenhof.

Eigen Haard, in collaboration with DOOR architects, set a design brief with the following circular targets:

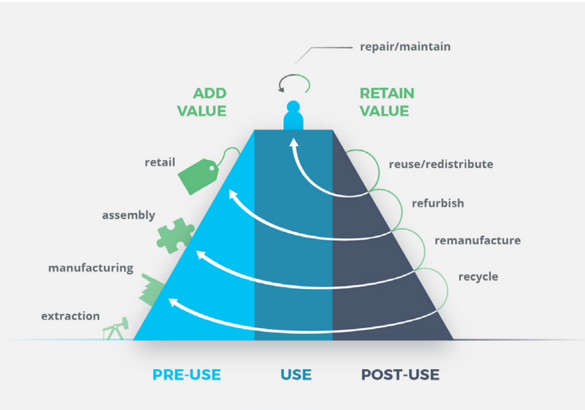
- **Harvest and re-use a minimum of 25% of existing building materials (e.g. use roofbeams as construction wood, roof tiles for new facades and paving stones for new roofs or in the garden)**
- **Use a Building Circularity Index (BCI)[4] > 50% as a guideline for the design**
- **Reduce unnecessary material (balancing aesthetics, technology and material use; avoid using materials solely for aesthetic purposes)**
- **Use materials with low environmental impact, Environmental Performance of Buildings[5] < 072 EUR/m2**
- **Apply modularity by using dry and accessible connections (e.g. installations that are easy to disassemble, moveable walls and modular kitchens)**

THE VALUE HILL

The Circular Economy is designed to extend the life of products for as long as possible, at their highest value. The Value Hill[6] framework (figure 1). shows different strategies to retain the value of a product. The further downhill, the more value is lost.

Figure 1: The Value Hil. Adapted from Achterberg et al. (2016).

ELEMENTS, PRODUCTS AND



It is all about modular building. Anything that cannot be replaced, remanufactured or recycled - that is which cannot be demounted and re-used elsewhere - belongs to an old world, not in the new world of circular construction.

Harald Friedl
CEO, Circle Economy

Figure X: Title goes here

MATERIALS

Applying the Value Hill concept to the construction sector means, first, reusing elements (e.g. boilers); where that is not possible, the second option is to re-use products (e.g. pipes); if that is not possible, the next option is to re-use materials (for example recycled metals).

This sequential approach to maintain value at the highest level for as long as possible, can be understood in the following order: Elements, Products, Materials (EPMs)[7]. Applying modularity[8] in design, in such a way that outdated or broken modules can be easily replaced, is a means to keep value at the highest level, as visualised in figure 2.

Currently, material recycling is predominant, although this is considered to be the lowest-value strategy for a circular economy. The Value Hill reflects the high energy consumption of making building elements from raw resources, whereas it is preferable to maintain the value of elements and products rather than to recycle materials.

An approach which keeps EPMs at highest value brings about the evolution of a reinforcing mechanism, that is: designing modular. Easy to disassemble EPMs will increase (residual) value resulting in the increased use and demand of these EPMs, further increasing (residual) value et cetera.

Figure 2: Hierarchy of Elements, Products and Materials (EPMs)

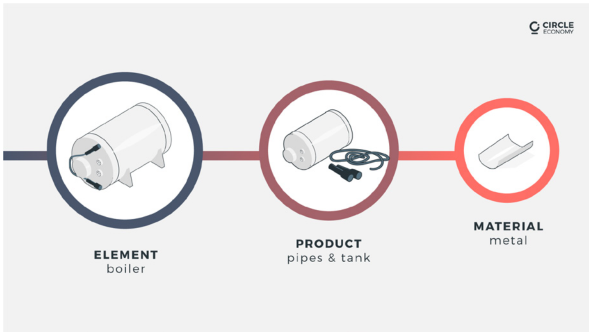
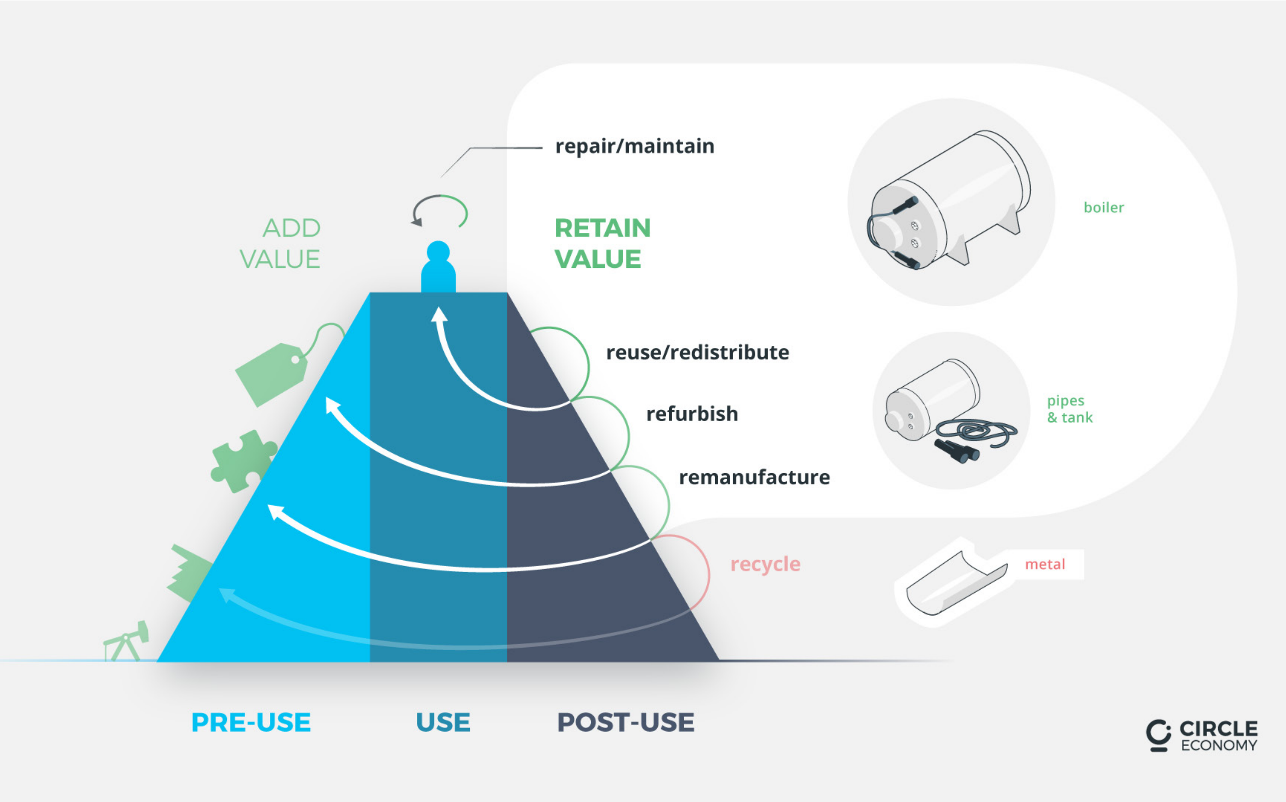


Figure 3: Elements, Products and Materials (EPMs) on the Value Hill. Adapted from Achterberg et al. (2016).

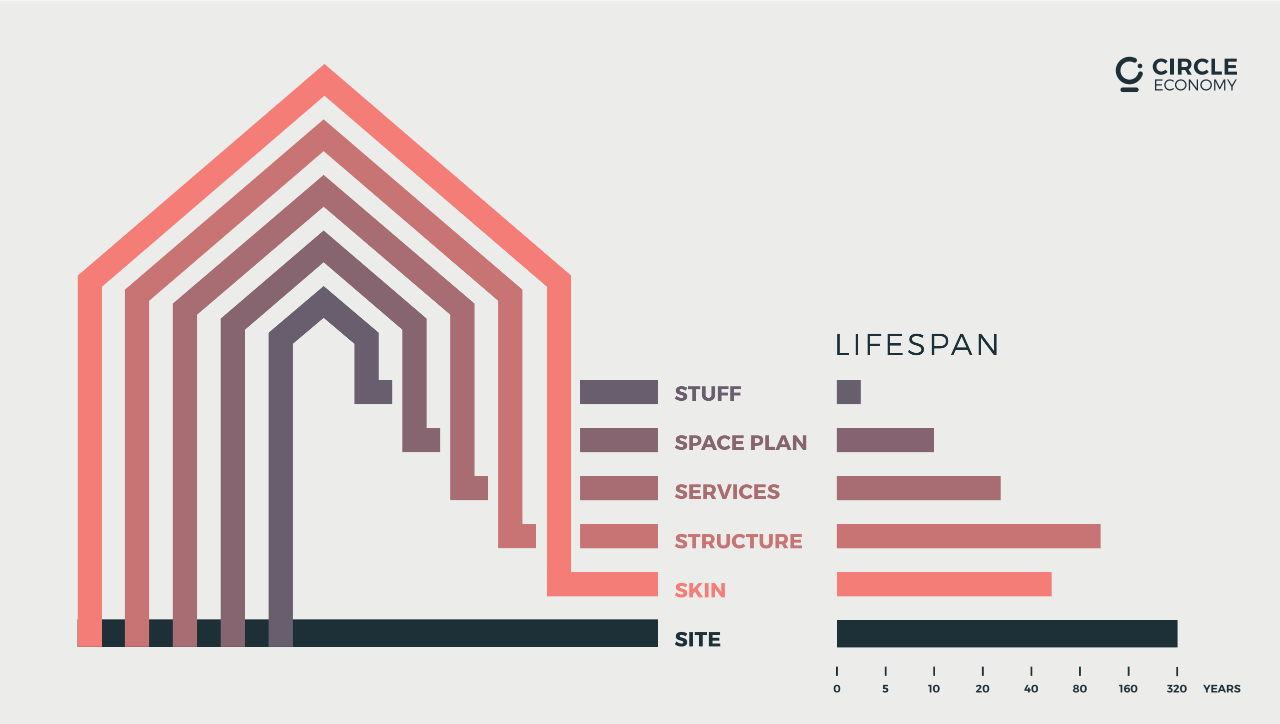


REUSING EPMS

When considering the re-use of EPMs, remaining lifespan, total cost of use (TCU) and disturbance of the users due to maintenance and replacement activities should be taken into account.

Example: Windows Fridtjof Nansenhof
Fridtjof Nansenhof is built for a long term purpose. The windows harvested from the current buildings at Fridtjof Nansenhof have a remaining lifespan of 10-15 years. Given the high costs and disturbance to residents of replacing the windows it was decided not to re-use the current windows in the new design. However, these windows can be repurposed in semi permanent buildings, in renovation projects or as windows inside buildings (i.e. not exposed to weather conditions) since this decreases wear and tear substantially.

Figure 4: 6 building layers, adapted from Steward Brand (1995)



ONE BUILDING, SIX LAYERS

Modular building, conceptually, is older than circular economy and considers the building not as one object, but as a collection of layers with each layer having its own function, EPMs and lifespan (see figure 4).

Looking at a building as a collection of layers that can be divided into elements, products and materials (EPMs) creates a new perspective. The varying lifespan of layers and EPMs demands a more detailed approach, informed by data about what EPMs are used where and when, and when they can be harvested. Moreover the design, building, using and harvesting activities should inform one another to coordinate the construction process.

PROCESS VERSUS PRODUCT

Previously, we have discussed different ways of looking at a building, i.e. the product. However, circular construction addresses both product and process, which implies a different starting point. Instead of starting with the design of a new building, the first step is to look at what is already there. Complete information about available and reusable EPMs is unknown at the start of the project. The further the product is designed and developed, the fewer changes can be made.

Taking into account the different starting point and a different understanding of what a building is (6-S), means we have to build in a radically different way. The design, construction and harvesting process need to interlink closely: communication and cooperation between different players is key. Innovation takes time, but companies that experiment and routinize these innovative processes will gain competitive benefits in the long term.

CHAIN COLLABORATION

In circular construction, chain collaboration is essential. Requirements are different compared to linear construction, and economic incentives need to be aligned throughout the process to reward circularity. Currently, the commissioning of a building is typically accompanied by a set schedule of requirements informed by current (linear) best practices. New guidelines can foster circular ambitions from the start.

Circular ambitions can be formulated in the form of requirements of layers and EPMs, like a re-use percentage versus new EPMs. Moreover, circular ambitions can be fostered by optimization (making better use of what is already there) and digitization strategies (BIM models, material passports), TCO/TCU[9] approximations, or structuring incentives rewarding circularity. These ambitions should be supported by explicit guidelines on chain partners' responsibilities and collaboration, and in turn these guidelines should stimulate chain partners' early involvement to inform design decisions and partners' continuous switching between the perspective of their own responsibility (specific EPMs) and the construction process and product over time (building, using and harvesting of the building).

An enhanced understanding of the bigger picture improves collaboration, fine tuning between different layers and overall quality of the building. The commissioning role changes from commander to a coordinator of the chain.

FLEXIBILITY IS KEY

The real estate market is constantly subject to fluctuating economics, demographics and market demand. Designing for adaptability increases the value of a building by allowing its use to evolve beyond its original intent. The flexibility of a building can be enhanced on various levels, for example: the foundation and structure could allow for future add-ons (extra wing / storeys); while an open floor plan could increase the internal use flexibility (this can be seen in old factory buildings, that are popular for converting to apartments thanks to the flexible open floor plan).

Increased flexibility of EPMs enables unlocking circular value. EPMs that can be more easily installed and demounted, accessed, maintained, repaired, refurbished and recycled create opportunities to increase (residual) value of EPMs.

MODULAR KITCHEN

A kitchen is typically installed and removed in its entirety. But what if you could easily change or add extra modules according to changing needs and wishes?

The Technical University of Delft, Chalmers University of Technology (Gothenburg), AMS Institute (Amsterdam), and industry partners[10] including Bribus and Eigen Haard, are currently developing a modular kitchen. This kitchen exists of a docking station and modules that can be demounted based on their function and expected lifespan to preserve optimal material value. Several connectors are being tested to connect separate kitchen parts in a simple and accessible way whereby there is no need for tools or specialist knowledge. This enables easy assembly and disassembly. Modularity allows easy personalisation (e.g. certain kitchen appliances) and flexibility (e.g. extension).

Modules will be taken back for repair, refurbishment and remanufacturing and are prepared for a new lifecycle. Take back can be arranged in a 'buyback' agreement. When the supplier remains owner of the kitchen circular value opportunities are created such as Product-as-a-Service (PaaS)[11]. Currently legislation concerning permanently attachment of items (i.e. items connected to a building legally belong to the owner of the building) poses certain barriers for PaaS in the construction sector.

FRIDTJOF NANSENHOF: FOUR EXEMPLARY CIRCULAR TOPICS

The starting point of the CoP were the existing buildings at Fridtjof Nansenhof and the preliminary design of the 67 new apartments. We decided to focus on the circularity of four exemplary topics, that are described in more detail throughout the white paper.

1. Re-use and lifespan extension of foundation
   We explored whether the current foundation could be re-used in the new design. This deemed infeasible because of the uncertainty about the safety of reusing the current foundation due to fluctuating groundwater levels, and a mismatch of the building footprint to the new design. For the new foundation, the attractiveness of additional investments for lifetime extension (i.e. future re-use purposes) were explored by comparing investments and net present value for different scenarios (see Annex C).

2. Re-use windows
   Reusing the windows of the current houses was evaluated as a priority but deemed undesirable since the remaining lifespan of 10-15 years was too short for the purpose of the new building. However, the windows of the current buildings will be harvested and Eigen Haard takes responsibility for finding another purpose for these windows making sure the value of the remaining lifespan is utilised, for example as indoor windows, renovation or for semi permanent buildings.

3. Explore modular kitchens
   Kitchen maintenance, repair and replacement is a substantial expense for Eigen Haard. If they can use kitchen modules, these can be replaced if needed, extending the lifespan of the kitchen as a whole. Moreover by offering different kitchen modules users can adjust the kitchen according to their preferences.

4. Explore Climate & Energy-as-a-Service
   The attractiveness of climate and energy-as-a-service (CaaS) versus ownership was explored. Combining climate and energy systems leads to more efficiency. Moreover, it can be beneficial to buy climate and energy-as-a-service where the service provider is owner of- and responsible for the system's maintenance, repair and replacement in exchange for a periodic fee. This stimulates the service provider to install a durable system that is easy to maintain and repair. Moreover, Eigen Haard is relieved from the burden to check and maintain the systems. Annex B shows a comparison of investments and net present value for different scenarios.

3 - TECHNOLOGY-DRIVEN CHANGE

USE OF RE-USED EPMS

Circular construction is contingent on access to, and demand for, re-used EPMs. Markets for re-used EPMs are still in a start-up phase. Supply from harvest sites is insufficient and not effectively mapped to, or harmonised with, the demand from new projects.

This Catch 22 situation - a lack of information on what EPMs are available, and at which point in time - suppresses demand, causing an on overall lack of liquidity of EPMs. Moreover, current regulations hamper rather than stimulate markets for the re-use of EPMs, while some current legislation demands 'new' EPMs. New standards and mandatory requirements for a certain percentage of used EPMs would act as a market catalyst for circular construction.

GATHERING, STORAGE AND EXCHANGE OF DATA

Transparency in used materials and products in the built environment is an essential starting point to generate new business models based on principles of circularity: What is used where and when will it become available again? New technology can help, as Building Information Models (BIM) provide information about new and recent constructions and 3D scanning and big data analyses support the gathering of insights in our existing built environment.

The gathering, storage and exchange of data in the built environment is supported by a wide range of scientists, consultants, service providers and business developers. They stimulate the transition of the construction industry, create new opportunities, but also new risks. Awareness is required for the realisation of a level playing field where access to and utilisation of EPM data is properly governed with respect for privacy, security and transparency.

STANDARDISATION AND PLATFORMS

How should data be structured and organised to deliver us information? In order to re-use construction materials, we need to know how the original materials were mounted. Should we create full size digital twins[12] of new buildings, or is a brief description of essential products sufficient for future re-use?

Standardisation of how we document is rapidly developing, supported by organisations like BuildingSmart. Their IFC[13] data model facilitates BIM and supports the creation of new standards for concepts like remountability or circularity. With these new and standardised datasets, benchmark comparisons can be made between construction objects, trading platforms for re-used EPMs can be sourced and rules and regulations can be drafted by supervising entities. New business models that emerge are, for example, the consulting services of ALBA Concepts, who provide insight in the level of circular principles that are applied in construction design, or the digital marketplace operated by ReUse Materials.

The Madaster platform initiative provides an online registration functionality where digital construction data (including BIM) from construction owners and industry stakeholders like constructors, financers and manufacturers can be automatically analysed, stored, exchanged and published in Building or Material Passports. The platform is governed by an independent not-for-profit foundation that assures financial stability, transparency and accessibility of (non-private) data to support a circular economy.

The transition towards a data supported circular construction economy does not hinder the development of circular business models based upon re-used EPMs. Marketplaces can already be sourced by urban harvesters or miners like New Horizon and Insert. Even though the stock taking of materials and products and matching of supply and demand requires extensive manual effort, a positive business case can often be made thanks to the quality of re-used materials. Additional incentives can be generated through stricter regulation with respect to (construction) waste processing and will emerge with a continuously increasing demand for new construction materials.

4 - VALUING CIRCULAR CONSTRUCTION

Circular construction – looking at a building as 6 layers, and prioritizing reusing elements above products above materials – has consequences for valuing real estate. Innovating the circular building process combined with a technology driven market development will increase residual value of EPMs. The question arises whether it makes more sense to look at the value of separate layers instead of the value of a whole building.

To get a better understanding of valuing layers, we looked at two layers: climate and energy systems and the foundation. Scenarios were built to compare the effects of circular alternatives on the cash flows and on cumulative net present value. These scenarios were discussed with property valuers, legal and financial experts. In these scenarios we did not discuss the technical properties (on EPM level) in detail. Instead, technical properties were given by engineers. This enabled us to focus on the financial consequences of choosing circular alternatives.

CLIMATE AND ENERGY SYSTEMS EXERCISE – OWNERSHIP VERSUS PRODUCT-AS-A-SERVICE

This paragraph provides insights in the comparison of two scenarios for the energy systems of Fridtjof Nansenhof. The current procurement of energy systems was compared with the alternative of acquiring climate and energy -as-a-service. In the latter variant, responsibility for the performance of these systems stays with the producer. This incentivises producers to create more durable systems and provide excellent services. Moreover, Eigen Haard is relieved from the burden to maintain the systems.

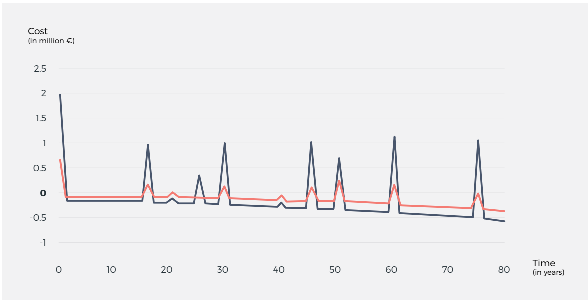
In current construction processes, architects and project developers consult specialist energy engineers to decide on the best climate and energy installations in terms of cost-efficiency. The real estate owner acquires the installation and becomes (financially) responsible for maintaining the installations during their lifespan. As the owner often has insufficient technical knowledge, a third party is paid to provide maintenance and repair activities.

Product-as-a-Service propositions extend producer responsibility and therefore incentivize the production of high-quality, modular products. In an ideal situation, manufacturers are responsible for their installations before, during and after their lifespan since they are most knowledgeable about how to optimise, maintain and re-use the value of its EPMs. Real estate owners can formalize this in their agreements with suppliers, for example, by using a buy/sell back agreement[14] or a product-as-a-service (PaaS) agreement[15]. The advantages of PaaS are having access to functioning climate systems for Eigen Haard tenants (i.e. unburdening of maintenance and repair responsibilities) and a guaranteed end-of-use take back of installations. Moreover, PaaS is paid as a recurring fee, relieving the real estate owner from an investment peak for installation costs. The potential of PaaS lies in better alignment between user and producer interests.

The long term benefits of circular alternatives can be set off against the short term benefits that are a common characteristic of linear practices. Impact should therefore be measured over a long time horizon, where we can expect that externalities will increasingly translate into real costs. The long term view makes circular alternatives more competitive.

In the exercise below, an 'ownership' scenario is compared to a 'Climate-as-a-Service (CaaS)' scenario over a period of 80 years. To build the different scenarios, information from energy consultant Buro Loo and comfort and energy-as-a-service (CaaS) provider THE FCTR E was used.

Figure 5: Cash out flow graph installations

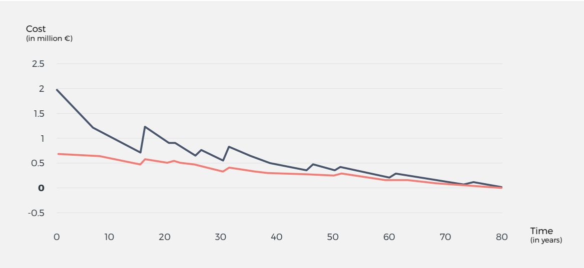


A) THE FCTR E membership

B) Eigen Haard ownership

Figure 5 shows the outgoing cash flows for both scenarios. The CaaS scenario results in a smoother line. Reflecting that, as the CaaS contract does include some investments to be made by Eigen Haard, such as: heat pumps, boiler vessels and solar panels. Eigen Haard invests in the remaining installation costs, as well as in the maintenance and repair of these elements. The (low) peaks in the CaaS scenario reflect these investment and maintenance costs. In the ownership scenario, all initial investment costs, maintenance and replacement costs are borne by Eigen Haard. However, Eigen Haard does not have to pay a recurring fee. This results in high peaks, offset by virtually no ongoing costs.

Figure 6: Cumulative net present value of installations



A) THE FCTR E membership
B) Eigen Haard ownership

Figure 6 shows the cumulative net present value of the cost of ownership and CaaS while using a discount rate of 5%[16][17]. Comparing scenarios, CaaS implies slightly lower net present value over an operating period of 80 years and is therefore financially more attractive. However, sensitivity analyses showed that basic assumptions about the indexation[18] of reinvestments have a significant effect on the outcomes and can lead to different conclusions. Detailed argumentation, calculations and sensitivity analyses are provided in Annex B.

OPPORTUNITIES AND RISKS OF CAAS

Product-as-a-Service is still a relatively new business model and may be perceived as more risky than conventional business models due to factors such as rolling contractual agreements, delayed profits, default risk and shifting financing needs. Preparation of proper contracts plays an important role in derisking Product-as-Service. For instance, clauses on safeguarding transferability of the contract towards a third party (i.e. new service provider) in case the service provider defaults on its performance, can boost confidence amongst financiers.

Product-as-a-Service also entails upside. Failing risks can be reduced thanks to technical expertise of the service provider. Moreover, maintenance and reinvestment costs are shifted from users to producers. By offering an ongoing service, producers can benefit from enhanced customer loyalty.

FOUNDATION EXERCISE – INCREASING FLEXIBILITY AND LIFETIME EXTENSION

The foundation of a building can last for up to hundred years,[19] yet, Eigen Haard depreciates foundations within fifty years. This is because of the economic lifespan of the building: the period of time during which the benefits of a real estate object are higher than the costs. Economic lifespan is determined by factors such as changing functional demands, increasing technological requirements, aesthetic and historical value. These factors determine whether a building is renovated or demounted. This way of decision making contrasts strongly to decision making based on the 6-S layers.

To prevent destruction of value embedded in the foundation, it is crucial to align economic incentives for its maximum technical lifespan. The design lifespan needs adaptability to meet changing demands. For the new design of Fridtjof Nansenhof, we looked at the costs of building a foundation in such a way to assure its bearing capacity can carry two extra housing layers in the future. This involves the use of additional piles or piles with a higher bearing capacity.

We found it can be cost-effective to make an initial investment in designing for adaptability and a longer lifespan. However, the business case highly depends on assumptions concerning depreciation, technical lifespan and discount rates. The most sustainable option currently seems unfavourable from a financial perspective. Nevertheless, reducing the need for new EPMs and future demolition and/or construction costs are arguments to take into account. Government stimuli, like levying extra taxes on material use, are needed to change the business case. Detailed argumentation and calculations are provided in Annex C.

FUTURE POTENTIAL AND LOCATION EFFECTS

The value of flexibility and lifetime extension can be expressed as the value of the existing building plus its future potential, minus the construction costs. Increased value can be taken into account, but this will vary according to the potential of the building itself, the location and market factors driven by supply and demand.

For instance, for a location in Amsterdam it is worthwhile to calculate future potential, as these houses likely will still be in use in the next century.

Conversely, investment in the future potential of a currently peripheral area can be more risky, and vulnerable due to a lack of liquidity or population trends. Investment decisions in additional future potential are, therefore, highly dependent on location profile and risk.[20]

How can we look at the value of separate layers instead of the broader picture of valuing a building? First, we need to understand how buildings are appraised and the balance sheet for buildings.

The value of buildings differs from the value of other products. For example, the value of a new car drops from the moment the car leaves the showroom. For buildings, we sometimes see the opposite effect: depending on location and supply-demand, they increase in value over time. Location plays an important role in valuing real estate.

Increasing value of the surroundings and/or the economic potential of cities can inflate prices substantially, resulting in situations where the same building in a city costs two, three or more times the price of the same building in a remote area. Although this is a logical market mechanism from an economic perspective, it may jeopardise the prospects for new circular construction.

Investing in location value compared to building value, that is composed of building layers and EPMs, downplays the relative importance of the building, its quality and durability. In the long term however, circular principles can enhance quality of life, which may in turn enhance the location value and desirability of new housing developments.

MARKET VALUE VERSUS COST PRICE AND VALUE IN USE

Appraising a building in the Netherlands is currently done with a Gross Initial Yield – Net Initial Yield calculation in combination with a Discounted Cash Flow (DCF) calculation. The calculation of the Gross Initial Yield – Net Initial Yield is a calculation of the market rent, costs for maintaining the market rent, and adjustment costs typically including a calculation of the discounted cash flows. With the DCF method, an appraiser typically looks at the net present value (NPV) of the rental income of the building over ten to twenty years. Besides the valuation of the appraiser, an accountant may include NPV of the asset on the balance sheet.

Historically, two valuation methods were common: historical cost price and market value. The historical cost price is a function of the construction costs. Market value is the commercial value of real estate and often reflects a higher value than historical cost price. Since 2016 the guidelines oblige to use the market value of the real estate.[21][22] If the aim is to exploit the real estate commercially, the financial return is important, and market value is the method of choice. If the owner's objective is to exploit the real estate for a long term societal function (as is the case for public buildings and social housing), it makes more sense to look at the value in use. Value in use means the discounted expected future cash flows, based on operating buildings against social rent, are put on the balance sheet. This value represents the extent to which repayments and interest obligations can be paid and based on the collateral and the eligibility (Loan to Value) for continued exploitation.

REFLECTING CIRCULAR VALUE ON THE BALANCE SHEET

The expression of layers and EPMs in the financial statements provides detailed insight into the value of buildings. The building as a whole is accounted for on the balance sheet itself. The annual accounts also contain an explanation of the balance sheet where the value per layer can be explained.

Moreover, for each building layer the lifespan and depreciation rate have to be estimated. The layer 'skin', for instance, can be depreciated over roughly thirty years whereas the layer 'structure' can last up to 150 years or even longer. Detailed depreciation of separate layers is essential to reflect the (financial) reality of circular buildings.

To value (circular) buildings adequately, valuation methods should explicitly emphasize different layers, their life span and value over time. In case (part of) a layer is acquired in the form of Product-as-a-Service, provisions for the obligation (i.e. recurring fee) towards third parties have to be taken into account. New IFRS 16 regulation requires inclusion of a provision in the balance sheet for listed companies that value according to IFRS.[23] The level of detail of estimation (on EPM level) should be balanced with resource constraints and the purpose of presenting a simple overview. A maturing market with comprehensive information on reusing EPMs will result in better estimations of residual value, depreciation and book value.

5 - FINANCING CIRCULAR BUILDINGS

Considering building layers separately can be a strength for the financial viability of the circular construction proposition. It should be possible to take this preserved value (from avoiding value destruction) into account in the financing. However, the increased value lies in the future, whereas financing takes place in the present. The financier is dependent upon the value as reflected on the balance sheet and on the value as stated in the valuation report made by an appraiser.

POTENTIAL SECURITIES IN CIRCULAR CONSTRUCTION

When building layers are taken into account, depreciation schemes become more precise in reflecting (residual) value of layers. These features are likely to have a positive effect on the circular business case. If building layers are managed separately by reusing EPMs instead of destroying value this implies more effective (re)use of value. If taken into account when valuing buildings, the re-use value can be interpreted as a security.

The overall residual value of EPMs is expected to increase in the coming years thanks to resource scarcity, increased availability of re-used EPMs and regulations. Finally, following the example of the foundation, increased flexibility and lifespan extension can also serve as a security.

CIRCULAR CONSTRUCTION AS RISK MITIGATION

A risk premium is a form of compensation for investors who tolerate the additional risk, compared to that of a risk-free asset, in a given investment. Since investing in circular construction demands a long-term horizon and is still in its early stages this currently translates into an increased risk premium when compared to non-circular investments. However, we can expect externalities to increasingly translate into real costs and hence make circular alternatives more competitive. Buildings are already subject to this mechanism in terms of energy consumption since they are required to have an Energy Performance Certification (EPC).[24] Mandatory certification and minimum standards resulted in buildings with poor energy efficiency having a lower value than buildings with a high energy efficiency. This shows the effect sustainability policy can have on the value of buildings.

A bespoke EPM label that details materials and scores circularity might increase transparency and create a reward incentive that encourages the use of circular EPMs - similar to favourable loan terms on better energy labels.[25] Following the example of the energy performance fee (EPV),[26] creating a compensation for efficient re-use of EPMs can further incentivise optimised EPM use. Other options are to incorporate circular EPM criteria into the environmental performance of buildings (MPG in the Netherlands[27]) or into BREEAM indicators.[28] If circular construction becomes the standard, non-circular buildings will decrease in value. Anticipating this shift of externalities translating into real costs can have a lowering effect on the risk premium, which can improve the capital position and lending position.[29]

REFINANCING FOR CIRCULAR VALUE

Typically, a social housing project may require financing for a duration of up to 30 years[30], whereas the actual use of the building will extend beyond that period. In the commercial real estate sector, tenor of loans are routinely raised for periods of 3-5 years before refinancing. The duration of a loan, when refinanced every time, may be extended over a longer timespan and/or the debt will be restructured, for example. This relieves the pressure and can improve the fit between the loan and exploitation period.[31]

Another solution can be to create balloons for refinancing. The additional investment to increase circular value should be made explicit in the initial investment, reflecting the fact that this value is not depreciated during this first loan period. The tenor (length) of the loan does not cover the entire depreciation period of a building. The linear repayment schedule might be based on an amortization period of 50 years or so, whilst the length of the actual loan is 3-5 years. This means that a balloon will be left at the end of the first loan, that requires refinancing.[32] In this case, a slightly higher balloon can compensate for the additional upfront investment. This enables taking the risk of the initial investment, while taking into account that part of this risk / future potential is transferred at the time of financial restructuring. This will nevertheless depend on, and must be made possible by, advancing insights of the future development of values and risks regarding EPM's.

Financiers in circular economy

New business models will require collaborative thinking about the economics and quantification of every business case. Circular business models generate value over a longer timespan, therefore it is essential to translate future value into the present financing.

Beyond an initial strategic dialogue, a banker's key skill is to identify and mitigate risks inherent in the creation of different ownership structures, such as Product-as-a-Service (PaaS) or Special Purpose Vehicles (SPVs).[33] A widely held view is that financing should be seen as an enabling factor in a web of interconnected parties in the transition to a circular economy. The reality is that financiers are subject to market forces, and will respond to the dynamics of the market.

In a circular economy, the various layers of a building retain value. Elements, products and materials (EPMs) ideally should not be depreciated until zero. However, EPMs are valuable only when there is demand. Currently, marketplaces for re-used EPMs are still in a start-up phase, making it hard to determine accurate future value - a complicating factor in financing (and refinancing) EPMs. Financing with uncertain future value requires risk-sharing, often in the form of a call on equity for the lender as a buffer against potential losses.

Within the prevailing financial system, investment decisions remain tightly focused on current perceptions of risk and reward. Transition to circular models requires a collaborative approach to refine established concepts of value in favour of new decision-metrics and long term value creation.

Separating location and building elements on the balance sheet should result in a different way of valuing and financing buildings when the developing market for repurposed building elements is more established.

Jan van der Doelen
Sector Banker Building & Construction,
Real Estate at ING

6 - KEY LEARNINGS

1 **Circular construction** is a new way of thinking about buildings and value: What do you build, when you build a circular building? What do you buy, when you buy a circular building? These questions depend on new decision metrics.

2 Increased gathering, storage and exchange of data from the built environment is supporting a **technology-driven** shift towards circular principles. This requires reliable governance of EPM data with respect for privacy, security and transparency.

3 Circularity can be expressed as **financial value** on the balance sheet by distinguishing between building layers. Differences between land (location) value and potential circular value of buildings need close analysis.

4 Incentives founded on **common standards** and new regulation are a catalyst for circular construction. Market mechanisms, such as penalties on virgin EPMs and other fiscal measures, can help to create a level-playing field.

5 **Cooperation** across the web of actors and stakeholders is key to translate circular economy principles into the calculation of financial ratios, specifically to limit depreciation and to adopt long term horizons for investment decisions.

6 More detailed **financial modeling** can highlight the potential value from circular construction. Financiers play a crucial role to identify and mitigate risks in the transition to a circular economy.

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ANNEX A - USEFUL LINKS

Material lists

- Nibe. Scientific comparison of construction materials and products. https://www.nibe.info/nl

Product lists

- C2C product database. Overview of C2C construction EPM's. https://www.c2ccertified.org/products/registry
- C2C bouwgroep. Online shop for C2C construction EPM's. http://c2cbouwgroep.nl
- Greenworks. Online shop for sustainable construction EPM's based on ten sustainability indicators. https://www.greenworksacademy.nl/producten/

Circular construction indicator

- Alba Concepts: Building Circularity Index (BCI). Calculation method to indicate circularity of buildings based on design for disassembly and waste scenario of materials and products. https://albaconcepts.nl/building-circularity-index/
- A framework for circular buildings - Indicators for possible inclusion in BREEAM. https://www.circle-economy.com/a-practical-approach-to-circular-buildings/

Digitalisation of construction EPMs

- Cirdax. Online application from Re Use Materials to register materials of existing buildings and manage re-use scenarios. https://www.reusematerials.nl/over-ons/
- Madaster. Online platform to create and manage material passports of new and existing buildings. The platform also measures circularity and financial value. https://www.madaster.com/nl

Market places for repurposing EPMs

- Re Use Materials. Online marketplace for repurposed EPMs. http://www.materialenmarktplaats.nl/
- New Horizon Urban Mining. B2B repurposing of EPM's. http://newhorizon.nl/.
- New Horizon Up-Store. EPMs which cannot be sold B2B are sold to individual consumers. https://up-store.nl/
- Circular Building Platform. Online second hand market place in development by BAM and several other construction companies. https://www.ondernemersbelang.nl/kennisbank/bam-is-op-weg-naar-100-procent-circulair-bouwen

ANNEX B – COMFORT-AND-ENERGY-AS-A-SERVICE

Two different climate and energy systems are compared over a timespan of eighty years for Fridtjof Nansenhof.

In variant (A) Eigen Haard Installations, Eigen Haard (EH) invests in comfort and energy (i.e. is the owner). In variant (B) THE FCTR E Membership, Eigen Haard has a membership with THE FCTR E, where THE FCTR E owns the installations and delivers "Comfort-and-Energy-as-a-service" (CaaS), to Eigen Haard against a monthly fee. In both instances, Comfort and Energy refers to heating, cooling, and electricity. Please note that there are uncertainties and assumptions in the lifetimes of the detailed elements of the installation costs. These assumptions influence the outcome of the business case and the variants.

Installation costs

Buro Loo has specified the costs of the installation for Fridtjof Nansenhof. The investment in the installation costs for each of the variants can be seen in Table 1.

Table 1: Cost Breakdown of the Two Variants

	Variant A Eigen Haard Ownership	Variant B THE FCTR E Membership
Hot water and heating	€ 854,526	€ 26,545
Drains	€ 20,225	€ 20,225
Plumbing	€ 294,213	€ 294,213
Air treatment	€ 189,113	€ 189,113
Electro-technical devices	€ 591,194	€ 117,906
Total	€ 1,949,272	€ 648,003

Variant A – Eigen Haard Ownership

EH invests the full installation cost of € 1.9 million which include the heat pumps and solar panels ensuring that the apartments in the new complex are independent of gas. These apartments will have a small residual electricity bill.

Variant B – THE FCTR E Membership

EH becomes client of THE FCTR E and pays a fee to receive CaaS in the apartments. THE FCTR E installs and connects the heat pump, boiler vessel and solar panels, therefore, the remaining installation costs estimated at € 648,003 must be invested by EH.[34] In addition, EH will pay a membership of € 140 per apartment per month, see breakdown in Table 2, below, and these apartments will have a small residual electricity bill of € 30.

Table 2: Breakdown of Monthly Membership Cost per apartment in Variant B

All-in membership (including financing, service, monitoring & maintenance)	€ 30
Heat pump + boiler	€ 74
Solar panels	€ 36
Total	€ 140

Standing charge warmth[35]

EH has the right to request a standing charge from its tenants in return for its investments in- and maintenance of installations. The standing charge is enforceable by the Heat Act[36] and will be tightened by 2019.[37] Because of this we apply the principle that we can pass on the full costs to the tenant in connection with the installation costs.

A service charge of € 152 per month covers the installation costs and the maintenance. The same fee (of € 152) is included in variant B: THE FCTR E Membership.

Reinvestments

Based on the available information, the lifespan of the various elements was estimated for a timespan of 80 years. Based on the lifespan of the elements, we know when re-investment in certain elements is needed. For example, we assume the heat pump has a lifespan of 15 years and plumbing works 50 years.

Normally investments are indexed with a normative construction cost increase of 2.5% per year. An important complicating factor in indexing the installation costs for the purpose of calculating the reinvestments is that they involve relatively new techniques. In the coming period we can expect (substantial) cost reductions thanks to the expected advantages of innovation and increased economies of scale, rendering the 2.5% estimate inaccurate. We assume that a price increase due to inflation is largely offset by a decrease in costs as a result of innovation and scale. Therefore, an index of 0,5 % per year was used in this exercise.

Maintenance

To compare the two variants, we have to take maintenance of the installations into account. In variant A, Eigen Haard Ownership, we assume maintenance costs of € 175 (0.6% of the purchase price) per apartment per year. In variant B, THE FCTR E Membership, we also assume maintenance costs of 0.6% which amounts to € 58 per apartment per year.

Indexing the membership (Variant B)

The components in the membership are indexed as follows:

- All-in membership — price inflation
- Heat pump + boiler — every 15 years a fixed amount based on the investment[38]
- Solar panels — every 15 years a fixed amount based on the investment

Similar to the Reinvestments segment: to what extent should economies of scale and innovation influence the indexation of the membership contributions for the heat pump, boiler and solar panels?

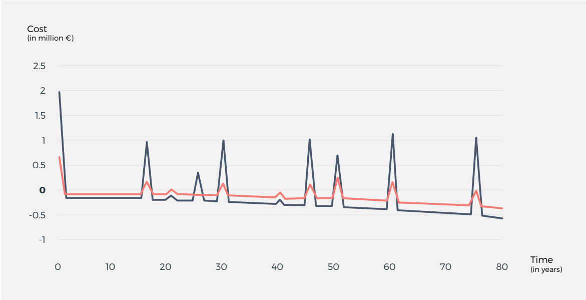
The way of indexing and the extent to which innovation and scale benefits are passed on to the customer have a strong influence on the financial business cases (see also sensitivity analysis below). We have chosen to base the membership fee for the heat pump, boiler and solar panels on an annual index of 0.5% on investments (similar to the assumption made for variant A).

Business case

Both variants are shown in a graph with cash flows and a graph with cumulative net present value.[39] The business case is based on the following assumptions:

- Index reinvestments: in both variants an index of 0,5% is applied.
- Index membership: the all-in membership fee is indexed annually with 2% price inflation and the fee for heat pump, boiler and solar panels are recalibrated every 15 years on the basis of an annual index of 0,5%.

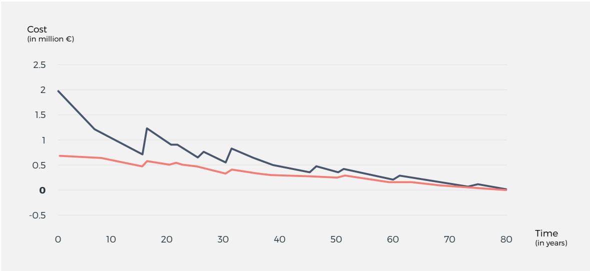
Figure 7: Cash (out) flow graph installations



A) THE FCTR E membership
B) Eigen Haard ownership

The peaks in the cash flows are caused by the reinvestments. Reinvestment costs are based on the estimated lifetimes of the elements and the installation costs. In variant B (THE FCTR E Membership) the reinvestment costs for Eigen Haard are considerably lower because THE FCTR E is the owner of – and responsible for reinvesting in – the heat pump, boiler and solar panels. The negative cash flows in this graph concern the incoming standing charge warmth contributions (revenues for Eigen Haard).

Figure 8: Cumulative net present value of installations



A) THE FCTR E membership
B) Eigen Haard ownership

This graph shows that variant B (THE FCTR E Membership) entails a slightly lower cumulative net present value over an operating period of 80 years and is therefore financially more attractive.

Note: Passing on the standing charge warmth of € 152 per month to the tenant is cost-covering in variant A (Eigen Haard Installations). In variant B (THE FCTR E Membership) this even results in a small profit for Eigen Haard.

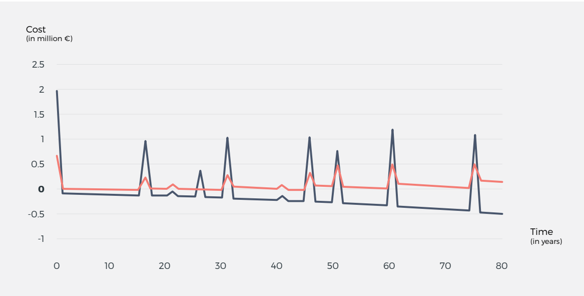
Preliminary conclusion: Variant B (THE FCTR E membership) is a more favorable business case than variant A (Eigen Haard Installaties).

Sensitivity analysis 1

Indexing membership heat pump + boiler and solar panels with 2.5% (in variant B).

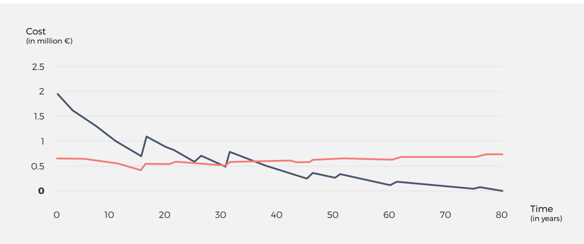
In this sensitivity analysis the membership fee for the heat pump, boiler and solar panels is recalibrated every 15 years based on an annual index of 2,5%, instead of an 0,5% annual index as used in the default business case. The question is: will realised cost reductions as a result of expected future economies of scale and innovation be applied by THE FCTR E in the pricing of the membership components towards Eigen Haard? Or is this part of the revenue model of THE FCTR E. If the membership fee for heat pump, boiler and solar panels are recalibrated every 15 years based on an annual index of 2.5%, this results in the following comparison of variant A and B.

Figure 9: Cash (out) flow graph installations based on sensitivity analysis 1



A) THE FCTR E membership
B) Eigen Haard ownership

Figure 10: Cumulative net present value of installations based on sensitivity analysis 1



A) THE FCTR E membership
B) Eigen Haard ownership

In this scenario, a break-even point arises in the 35th year. That is the moment where variant B (THE FCTR E Membership) turns out considerably more expensive. After an operating period of 80 years, the difference in net present value is € 767,776.

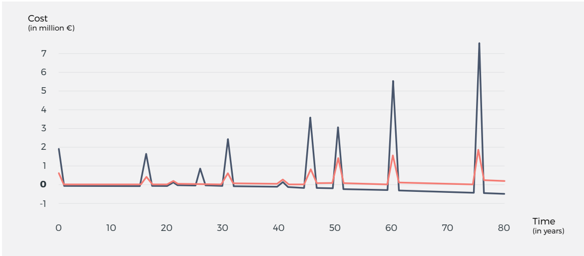
Sensitivity analysis 2

Indexing membership heat pump, boiler and solar panels index with 2.5% (in variant B) and indexing reinvestments with 2.5% (in both variants A and B).

The following assumptions apply here:

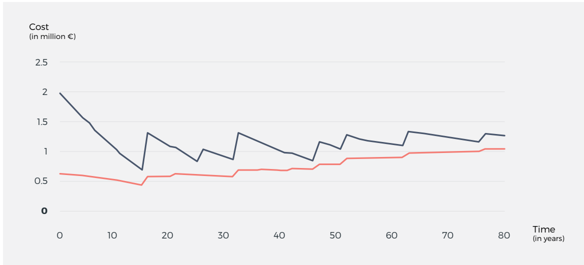
- Index reinvestments: In both variants an index of 2.5% is applied instead of 0,5%
- Index membership: the all-in membership fee is indexed with 2% price inflation annually and the fee for the heat pump, boiler and solar panels is calibrated every 15 years based on an annual index of 2.5% instead of 0,5%

Figure 11: Cash (out) flow graph installations based on sensitivity analysis 2



A) THE FCTR E membership
B) Eigen Haard ownership

Figure12: Cumulative net present value of installations based on sensitivity analysis 2



A) THE FCTR E membership
B) Eigen Haard ownership

In this scenario, indexing reinvestments with 2.5%, ownership becomes less attractive since the reinvestment costs increase substantially.

Conclusion based on sensitivity analyses:

If cost reductions resulting from economies of scale and innovation are not calculated in the membership pricing from THE FCTR E than this variant becomes less attractive. This is illustrated in sensitivity analysis I.

In general, the index used for reinvestments and membership components have a big impact on the outcome of the business cases. As discussed, knowing that the market for sustainable installations is developing and there will probably be cost reduction effects caused by economies of scale and innovation, estimating representative indices is a challenge.

ANNEX C - FOUNDATION FLEXIBILITY AND LIFESPAN EXTENSION

We looked at the costs and lifespan of three foundation variants. For this exercise we used the calculations for the foundation as stated in the design of the new Fridtjof Nansenhof apartments. For making assumptions about additional investment costs for the three variants we combined the foundation design with calculations of a structural engineer. Please note that this is merely an exercise to compare BAU (Business As Usual) and other, more circular, scenarios. Moreover, the exercise is based on the assumption that the building will retain its function for the full 150 years. This is an important assumption that will often not be realistic in practice. A practical point is that replacing the foundation is a very drastic intervention that will also have impact (and costs) on the superstructure. In this exercise we assume full replacement whereas in reality an alternative strategy is foundation repair.

Three foundation variants

The following three foundation variants are compared

A) Business as usual (BAU): the foundation is an investment of € 204,661 (price level t = 0). The foundation has a lifespan of 50 years, so over a period of 150 years the foundation is replaced in t = 50 and t = 100.[40]

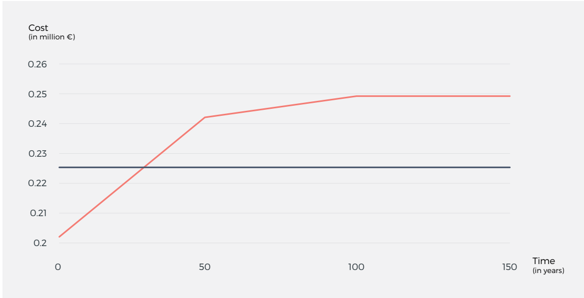
B) Extended lifespan (150 years): Based on calculations we assume an additional investment of € 20,466 is needed in t = 0 to increase the lifespan to 150 years. For an operation of 150 years, no additional investment is needed during the lifespan.

C) Extended lifespan (150 years) & extended floor capacity: if t = 0 € 92.097 extra is invested (assuming a 45% extra cost variant[41]) compared to the BAU, the foundation has a lifespan of 150 years and it is possible to add extra floors within the operating period of 150 years by the additional investment in, for example, extended poles. An additional investment in, for example, t = 50 or t = 100 is not necessary for an operation of 150 years.

- The price index for the foundation is 1.50% (annually).

- Discount rate is 5%

Figure 13: Cumulative net present value of installations based on sensitivity analysis 2



A) Total investment BAU
B) Total investment lifespan 150 years

Table 3: Investment costs of variants A and B

	0	50	100	150
Investment BAU	€ 204.661	€ 430.861	€ 907.067	€ 1.542.589
Present Value	€ 204.661	€ 37.573	€ 6.898	€ 249.131
A) Total investment BAU	€ 204.661	€ 242.234	€ 249.131	€ 249.131
Investment BAU	€ 204.661	€ 0	€ 0	€ 204.661
Additional investment lifespan 150 years Electro-technical devices	€ 20.466	€ 0	€ 0	€ 20.466
Present value BAU + extended lifespan T	€ 225.127	€ 0	€ 0	€ 225.127
B) Total investment lifespan 150 years	€ 225.127	€ 225.127	€ 225.127	€ 225.127

Variant A: Investing in the foundation three times over the period results in a total cash flow of € 1.5 million and a net present value is € 249,131.

Variant B: Investing in the foundation once at the outset with an additional investment of € 20,466 (t=0) results in a total cash flow of € 225,127, equal to the net present value as the entire investment takes place at t = 0.

Conclusion:

Scenario B is cheaper and more sustainable

C) Investing an additional € 92,097 (t=0) at the outset results in a the total cash flow of €296,758 - equal to the net present value as the entire investment takes place in t = 0.

Conclusion:

If, at t=50, you want to have the possibility to add additional floors to the building (or a new development on the existing foundation) then Scenario A BAU is cheaper.

Additional floors, from a financial perspective, will lead to the decision to invest 3 times in a BAU foundation over an operating period of 150 years; whereas through an environmental lens, 3 BAU foundations naturally cost more raw materials and generate more CO_2 emissions than making an additional investment in one foundation in t = 0 for extra capacity for extra floors.

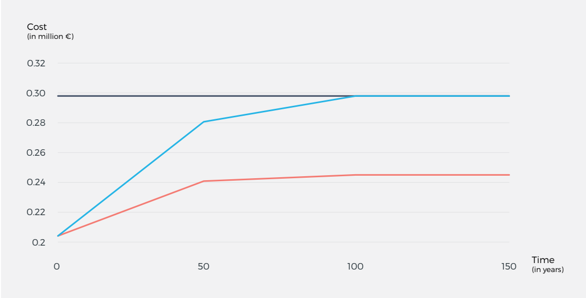
Tax on new material scenario

Consider the scenario in which the government decides to stimulate sustainable investment by levying extra taxes, for instance on new material, thereby promoting the efficient use of raw materials. Then how much extra tax is needed to change the financial business case to variant c?

We approached the break-even point by working with a tax on new material, in this case, in the foundations in t = 50 and t = 100.

The blue line in Figure 14 is the net present value of BAU 3 x foundation with an extra load on the investment for the foundation in t = 50 and t = 100. In this scenario the extra load has to be at least 107% in order to push the preference towards Scenario C.

Figure 14: Cumulative net present value of foundation variants A, C and C including tax incentive



A) Total investment BAU
C) Total investment lifespan 150 years
Total investment BAU incl. taxes

Table 4: Investment costs of variants A, C and C including tax incentive

	0	50	100	150
Investment BAU	€ 204.661	€ 430.861	€ 907.067	€ 1.542.589
Present Value	€ 204.661	€ 37.573	€ 6.898	€ 249.131
A) Total investment BAU	€ 204.661	€ 242.234	€ 249.131	€ 249.131
Investment BAU	€ 204.661	€ 0	€ 0	€ 204.661
Additional investment extended lifespan (150 years) & extended floor capacity	€ 92.097	€ 0	€ 0	€ 92.097
Present value lifespan 150 years and bearing capacity additional floors	€ 296.758	€ 0	€ 0	€ 296.758
C) Total investment lifespan 150 years and bearing capacity additional floors	€ 296.758	€ 296.758	€ 296.758	€ 296.758
Investment BAU incl. taxes	€ 204.661	€ 892.300	€ 1.878.508	€ 2.975.469
Present value BAU incl. taxe	€ 204.661	€ 77.812	€ 14.285	€ 296.758
Total investment BAU incl. taxes	€ 204.661	€ 282.473	€ 296.758	€ 296.758

Variant A-1 BAU technical lifespan 75 years instead of 50 years

Practice shows that traditional foundations last (much) longer than 50 years. Moreover, foundations that remain longer than 50 years often do not require foundation repair nor have poor foundation codes.[42] Therefore the comparison with variant A (BAU of a foundation that only lasts 50 years) may not reflect reality. Therefore we created another scenario to compare Variant A-1 (technical lifespan of 75 years) with Variant B.

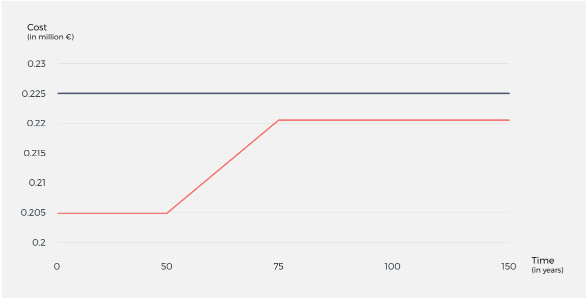
A-1): Investing in the foundation two times over the period results in a total cash flow of € 829,817 and the net present value is € 220,760

B) Investing in the foundation once at the outset with an additional investment of € 20,466 (t=0) results in a total cash flow of € 225,127, equal to the net present value as the entire investment takes place at t = 0.

Conclusion:

Variant b) is more expensive but more sustainable.

Figure 15: Cumulative net present value of foundation variants A-1 and B



A) Total investment BAU
B) Total investment lifespan 150 years

Table 5: Investment costs of variants A-1 and B

	0	50	75	100	150
Investment BAU (75 years lifespan)	€ 204.661	€ 0	€ 625.156	€ 0	€ 829.817
Present Value	€ 204.661	€ 0	€ 16.099	€ 0	€ 220.760
A) Total investment BAU	€ 204.661	€ 204.661	€ 220.760	€ 220.760	€ 220.760
Investment BAU	€ 204.661	€ 0	€ 0	€ 0	€ 204.661
Additional investment lifespan 150 years	€ 20.466	€ 0	€ 0	€ 0	€ 20.466
Present value BAU + extended lifespan	€ 225.127	€ 0	€ 0	€ 0	€ 225.127
B) Total investment lifespan 150 years	€ 225.127	€ 225.127	€ 225.127	€ 225.127	€ 225.127

Conclusion foundation exercise:

The business case highly depends on assumptions concerning depreciation and technical lifespans. The most sustainable option currently seems unfavourable from a financial perspective.

FOOTNOTES

1. Steward Brand (1995). How Buildings Learn - What Happens After They're Built.
2. Transitieagenda Circulaire Bouweconomie, (2018).
3. Coert Zacheriasse (2016).
4. The Building Circularity Index is a calculation method to indicate circularity of buildings based on design for disassembly and waste scenario of materials and products, created by Alba Concepts.
5. In Dutch: 'Milieu Prestatie Gebouwen' (MPG). The Dutch government recently implemented the MPG, which is a measurement to tax the environmental impact of materials applied in buildings (based on a LCA calculation method). Per 1 January 2018, project developers of new housing and offices larger than 100m² are required to perform below the maximim MPG value of 1,0 EUR/m2 per year.
6. The Value Hill (2016).
7. Throughout this white paper we use the abbreviation EPMs, referring to Elements, Products and Materials.
8. For more information on modularity see The Circular Phone (2018)
9. Total cost of ownership (TCO) is the purchase price of an asset plus the costs of operation. In circular economy thinking we can consider not only financial prices but also external (social and ecological) costs and benefits of owning an asset. Total cost of usage (TCU) takes this to a circular level by on using instead of owning an asset, allowing cost benefit analysis of Product-as-a-Service.
10. Industry partners of the modular kitchen project: Bribus, Vedum, Dirkzwager Groep, ATAG/ASKO, Waterweg Wonen, Woonbedrijf, Ymere, HSB, Syntrus Achmea Real Estate & Finance, and Eigen Haard.
11. Product-as-a-Service: The performance of a product is sold while ownership of the product remains at the manufacturer. Read more about PaaS in Create a financeable circular business model in 10 Steps & The Circular Phone.
12. Digital twin refers to a digital replica of physical assets (physical twin), processes, people, places, systems and devices. The digital representation provides both the elements and the dynamics of how an Internet of things device operates and lives throughout its life cycle (Wikipedia).
13. Industry Foundation Classes (IFC) are the open and neutral data format for openBIM (www.buildingsmart-tech.org).
14. Buy/ Sell back agreement: The supplier agrees to buy back the product at the end of its lifespan on terms agreed in advance. It is therefore a bit like paying a deposit. (https://mvonederland.nl/circular-procurement-guide).
15. See footnote 11 about Product-as-a-Service
16. The discount rate refers to the interest rate used in discounted cash flow (DCF) analysis to determine the present value of future cash flows. Discounted cash flow (DCF) is a valuation method used to estimate the value of an investment based on its future cash flows. The cost of capital is the minimum acceptable rate of return on capital investment. It is an opportunity cost of capital, because it equals the expected rate of return on capital investment opportunities open to investors in financial markets. Brealey, Myers, Allen: Principles of Corporate Finance – 11th Global Edition (2014).
17. 5% is the standard discount rate in the social housing sector.
18. Indexation is a technique used by organizations or governments to connect prices and asset values to inflation (Investopedia).
19. Steward Brand (1995).
20. Fakton addresses risk profiles of different regions in their evaluation guidelines.
21. Prior to 2016, Eigen Haard valued their portfolio using historical cost price, distinguishing between the building and the land on which the building was built.
22. Accounting directive 645 for housing corporations. Recently, AW and WSW created an addition to directive 645 proposing a new valuation method that takes into account that part of the market value can not be realized and is therefore 'intended' for social policy.

23. IFRS means International Financial Reporting Standards. For companies that do not value according to IFRS, provisions for Product-as-a-Service are an off-balance item that should only be explained. This new IFRS regulation was trialed in 2018 and is obligatory since 2019.

24. https://www.government.nl/topics/energy-performance-certificates-for-homes-and-buildings.

25. If a building meets the ESG criteria of the bank and / or qualifies for financing by the 'Green Bank' facilities, this may result in lower interest rates (surcharges). (https://www.ing.com/Sustainability/Societys-transition/ING-Groenbank.htm).

26. Energie Prestatie Vergoeding (Dutch).

27. Milieu Prestatie Gebouwen (MPG, Dutch). A method to determine the environmental consequences of using specific materials. (https://www.rijksoverheid.nl).

28. A framework for circular buildings (2018).

29. Housing corporations depend on financial criteria set out by WSW (Waarborgfonds Sociale Woningbouw is a Dutch independent institute that optimises financing for real estate in the public sector) and AW (Autoriteit Woningcorporaties is the Dutch supervisor of housing corporations). Close collaboration with these organizations is necessary to look at opportunities and risks of the new business case and to alter the criteria accordingly.

30. Thanks to WSW guarantees, housing corporations can have a longer financing period than commercial developers.

31. For more information on financing issues in the circular economy, also see FinanCE working group (2016); Fischer & Achterberg (2016).

32. Note: Where future value is assumed, the inherent risk is potential failure to harvest due to unfavourable market conditions. Risk is lowered if markets explicitly value circular aspects, i.e. reusable EPMs.

33. A Special Purpose Vehicle (SPV) is a legal entity created to fulfill narrow, specific or temporary objectives. SPVs are typically used by companies to isolate the firm from financial risk. (Wikipedia)

34. These estimated costs, that will be borne by Eigen Haard in Variant B, are based on the available knowledge of Buro Loo and a sustainability advisor of Eigen Haard.

35. Vastrecht warmte (NL).

36. Warmtewet (NL).

37. After the amendment of the Heat Act, landlords who provide heat to their tenants with flat block central heating or a heat and cold storage installation will no longer be subject to this lawThis also applies to Associations of Owners who supply heat to their members. From that moment on, landlords may charge the costs for the heat supply to tenants as service costs (Arcadis).

38. A fixed amount is paid in years 1-15; for example, for the solar panels € 36 per month. For the period year 16-30 a new fixed amount is determined on the basis of the indexed investment costs of solar panels. If we assume an annual indexation of 0.5% on the investment of solar panels, the contribution for solar panels in the period of year is 16-30 € 39 per month.

39. To calculate the net present values, a discount rate of 5% has been used. This discount rate of 5% is used sector-wide.

40. Please note that the foundation is depreciated over 50 years. However, a foundation can have a longer technical lifespan. This depends on circumstances like durability of used materials and wear and tear. This severely impacts the comparison of scenarios. Variant A-1 below provides a comparison between BAU of 75 years technical lifespan and variant B of 150 years.

41. Note: The structural engineer deems a bandwidth of between 25-45% realistic.

42. Foundation codes - A foundation code (funderingscode) shows the quality of the building shell and the foundation. It also shows how soon the foundation will need to be repaired. A foundation code is always part of a foundation report.

COLOPHON

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THE COMMUNITY OF PRACTICE

The transition to a Circular Economy requires innovative business models that stimulate optimised use of repairable products, reusable components and recycling of materials. A Community of Practice was established in which experts from different fields collaborated to improve the financeability of circular construction. Members engaged in a case of social housing corporation Eigen Haard. This report retraces the 'learning-by-doing' trajectory of this Community of Practice. It provides tools to unlock the potential of circular construction business models.