



The Financial Tab

An explanation of the financial module within the Madaster platform

Made for
Madaster users

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1 Introduction

1.1 Motivation

On September 29, 2017, the Madaster platform was launched. From this public online library, a digital materials passport can be generated for every real estate object. As a result, Madaster provides insight into which materials have been used in a building and in what quantities. Madaster gives materials an identity so that waste streams can be eliminated, and in doing so Madaster contributes to the transition towards a circular economy.

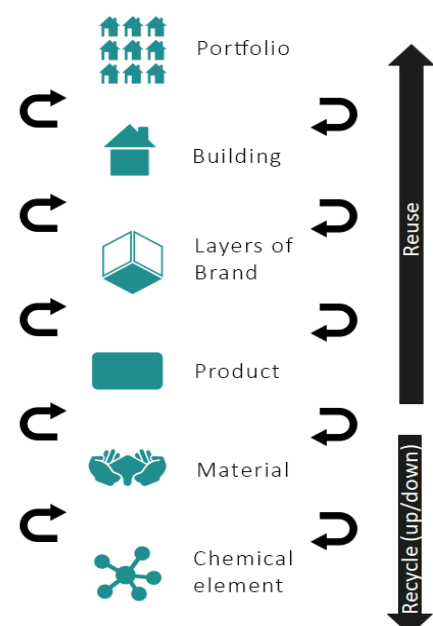
In addition to documenting the materials in a building, Madaster aims to give the documented materials a financial value. This financial value counts as personal characteristics such as date of birth or place of birth for a 'personal' passport. The rationale behind it is that to stimulate circular economy a financial trigger must be present. Therefore, in the financial tab, the residual value of materials is calculated. This data can be used, among other things, for making circular propositions in the market. Where now demolition-related depreciations of building owners are estimated based on feeling and key figures, the financial tab can determine more precisely what the final value is based on material value as an absolute minimum value. As more detachable and sustainable materials are built, the residual value becomes higher. Thus, the financial module is a driver for the circular economy and translates circularity into money.

For banks, investors and other property owners, determining a terminal value is important for a number of reasons. First, knowledge of the buildings' composition reduces the risk factor for demolition-related write-offs. In addition, the material value of a building can be representative of the terminal value of a building. This end value can provide a more positive business case when making the investment decision at construction or when purchasing the building. In this way, circularity is linked to residual value and thus to money. Through the financial tab, Madaster enables the market to seize opportunities for new business models.

1.2 Scope and assumptions

Within the scope of the financial tab are material, product, and shearing layers. The building value and shearing layers' value represent the sum of the material and product values. With the material value, the lowest grade of recycling and the last level for reusing material is approached. The product level valuation is most likely a higher for the materials are manufactured into a functional unit. Product value is represented by the reuse value of products, which may consist of multiple products themselves.

For example, an air conditioning unit can be considered a product, just the outside cabinet can be considered a product, or the screw that secures it to the wall can be considered a product. Hence, the definition of a product is flexible.



2 Theoretical principles

2.1 Material value

2.1.1 Material

The material value is determined by taking the commodity value or market value of materials as the basis. This value is then reduced by the correction factors. These correction factors represent the cost of extracting the materials from the building, which are:

- Demolition and dismantling costs
- Additional transport costs to the processor
- Processing and machining costs
- Correction for size of raw material flow

The formula for calculating the material value of one specific material at $t=0$ is:

$$W_{K.1;t=0} = (W_{k.1} - F_{k.1.1} - F_{k.1.2} - F_{k.1.3}) * F_{k.1.4}$$

where:

$W_{K.1}; t=0$	Value of material K.1 at time $t=0$
$W_{k.1}$	Value of material K.1
$F_{k.1.1}$	Correction factor 1: Demolition and dismantling costs
$F_{k.1.2}$	Correction factor 2: Additional transport costs to the processor
$F_{k.1.3}$	Correction factor 3: Processing and machining costs
$F_{k.1.4}$	Correction factor 4: Correction for the size of the raw material flow

2.1.2 Correction factors

2.1.2.1 Demolition and dismantling costs

The demolition and dismantling costs for a building are currently assumed at predefined Dutch standards per m^2 GFA (Gross Floor Area). These costs are divided among the materials based on volume.

The formula for this is as follows:

$$F_{K.1.1;t=x} = (TSDK_{Gebouw} / M_{gebouw}) * M_{K.1}) * (1 - LI_{k.1}) * i_{bdb;t=x}$$

Where:

$FK.1.1; t=x$	Demolition and dismantling costs of material K.1 at time x
$TSDK_{Gebouw}$	Total demolition and dismantling costs of a building
M_{gebouw}	Total mass of the building
$LI_{k.1}$	The looseness index of the material
$i_{bdb;t=x}$	BDB index from $t=0$ to $t=x$

2.1.2.2 Additional transport costs to the processor

The additional transport costs to the processor are calculated using the following formula:

$$F_{K.1.2; t=x} = A_{Verwerker} * \frac{\text{€}}{\text{km/kg}} * i_{inflatie; t=x}$$

Where:

$F_{K.1.2; t=x}$	Additional transportation costs to the processor at t = x
$A_{Verwerker}$	Distance to processor (see Chapter 3.2.2)
$i_{inflatie; t=x}$	Inflation from t=0 to t=x

2.1.2.3 Processing and machining costs

$$F_{K.1.3; t=x} = K_{Verwerker} * i_{inflatie; t=x}$$

Where:

$F_{K.1.3; t=x}$	Processing and machining costs at t = x
$K_{Verwerker}$	Processor cost per kg (see Chapter 3.2.2)
$i_{inflatie; t=x}$	inflation from t=0 to t=x

2.1.2.4 Correction for size of raw material flow

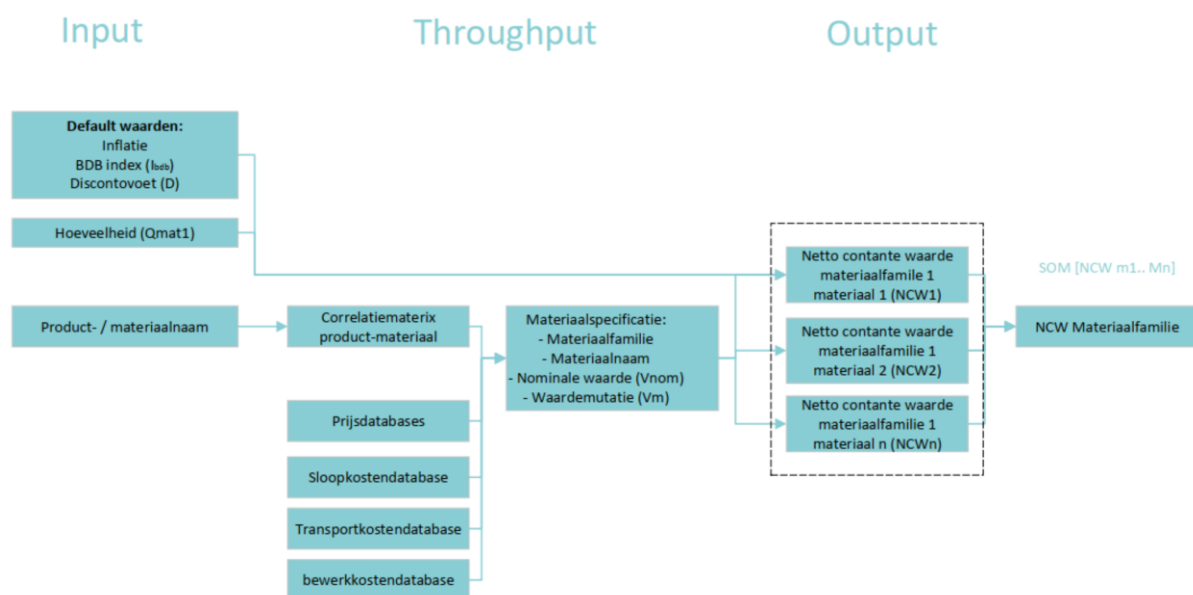
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2.1.3 Future Value

Knowing the value of the materials within a building at $t=0$ is already very innovative and valuable. However, it is even more valuable to know the net present value (NPV) of the materials in a building, assuming that a building layer is dismantled when its functional life is over.

To determine the future value of the materials, it is important to know whether a material is increasing or decreasing in value and how fast this is happening. To determine this, only the data from the past was looked at in the most objective way possible. This historical data from commodity prices is corrected for inflation and exchange rates in order to obtain the fair value. Using the fair values from the past, a trend line is drawn towards the future. This is done using the regression analysis called “least squares method”.

This method is applied per material. To then calculate the net present value of the material family, the net present values of the different materials are added up. The process diagram, explaining how a net present value was arrived at, is shown below.



2.1.4 Product Value

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3 Sources

3.1 Materials

Material	€/kg	Historical prices
LDPE flake		Supply & Demand
LDPE pellet		Supply & Demand
LLDPE		Supply & Demand
HDPE		Supply & Demand
PP homopolymer		Supply & Demand
PP copolm		Supply & Demand
PVC		Supply & Demand
ABS natural		Supply & Demand
ABS black		Supply & Demand
PA 6 natural		Supply & Demand
PET crystal clear		Supply & Demand
PC crystal clear		Supply & Demand
PBT natural		Supply & Demand
POM natural		Supply & Demand
PMMA crystal clear		Supply & Demand
Material	€/kg	Historical prices
Aluminum		LME
Copper		LME
Zinc		LME
Nickel		LME
Lead		LME
Tin		LME
Aluminum Alloy		LME
NASAAC		LME
Steel Billet		LME
Steel Scrap		LME
Steel Rebar		LME
Cobalt		LME
Molybdenum		LME
Gold		LME
Silver		LME
Palladium		LME
Platinum		LME

Material	€/kg	Historical prices
Hardwood log	0,18	
B-wood	0,18	
Softwood log	0,18	
Cork	1,00	
Material	€/kg	Historical prices
Concrete Granules	0,0035	Interview BRBS & GBN
Mixing Granule	0,0030	Interview BRBS & GBN
Ceramics	0,05	Sand Complete
Asphalt granules	0,0075	Hellinga
Plaster	0,024	Cobouw Construction Costs
Gravel	0,016	Cobouw Construction Costs
Asbestos	0	
Material	€/kg	Historical prices
Flat Glass	0,19	Addition of material prices of the composition
Material	€/kg	Historical prices
Wool	source	https://www.quandl.com/data/ODA/PWOOLC_USDCoarse-Wool-Price
Rubber	source	https://www.quandl.com/data/COM/WLD_RUBBER_TSR20Rubber-TSR20-kg
Cotton (airtight)	source	https://www.quandl.com/data/COM/COTTON-Cotton-ICE
Sand	0,033	Average price from different sources
Material	€/kg	Historical prices
Unknown	0,00	

3.1.1 Pricing approach

Some material prices are not found as commodity prices. This is often the case with materials that have a local market rather than a global one. An example is minerals. These materials are worth relatively little but are costly to transport. As a result, there is no national, European or global market. The price was therefore determined locally based on supply and demand. An average price for this was found out on the basis of interviews. An average price has been determined on the basis of interviews.

The price of flat glass was determined by ordering the raw materials for glass per ton. Based on the purchase prices, a value of €0.19 per kg emerges from the inventory.

For the material family “Wood” the calculations were based on the calorific value of wood. The downcycling scenario, i.e. incineration, was thus taken as the starting point. The calorific value is set against an average energy price of 3.5 cents. This is the average price of energy of 2017 excluding tax, delivery costs etc.

The price of sand was determined based on a comparison of a number of providers. The remainder of the prices are based on community prices from various world markets.

3.1.2 Correction factors

Starting points for the correction factors are as follows:

- Demolition and dismantling costs are based on Dutch standards
- Transport costs are €0,00048 per kg per km
(the table below shows which materials travel which distances)
- Treatment and processing costs for plastics are €0.75 per kg
- Machining and processing costs for metals are 35% of the value
- Other material specific machining and processing costs are as stated

Transport distances					
Plastic	Metals	Wood	Stone	Glass	Organic
150	150	50	20	150	150

Hardwood log	€ 0,05
B-wood	€ 0,10
Softwood log	€ 0,10
Concrete Granules	€ 0,007
Mixing Granule	€ 0,007
Plaster	€ 0,015
Gravel	€ 0
Asbestos	€ 0,23
Flat glass	€ 0,20

3.2 Products

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3.2.1 Product Value

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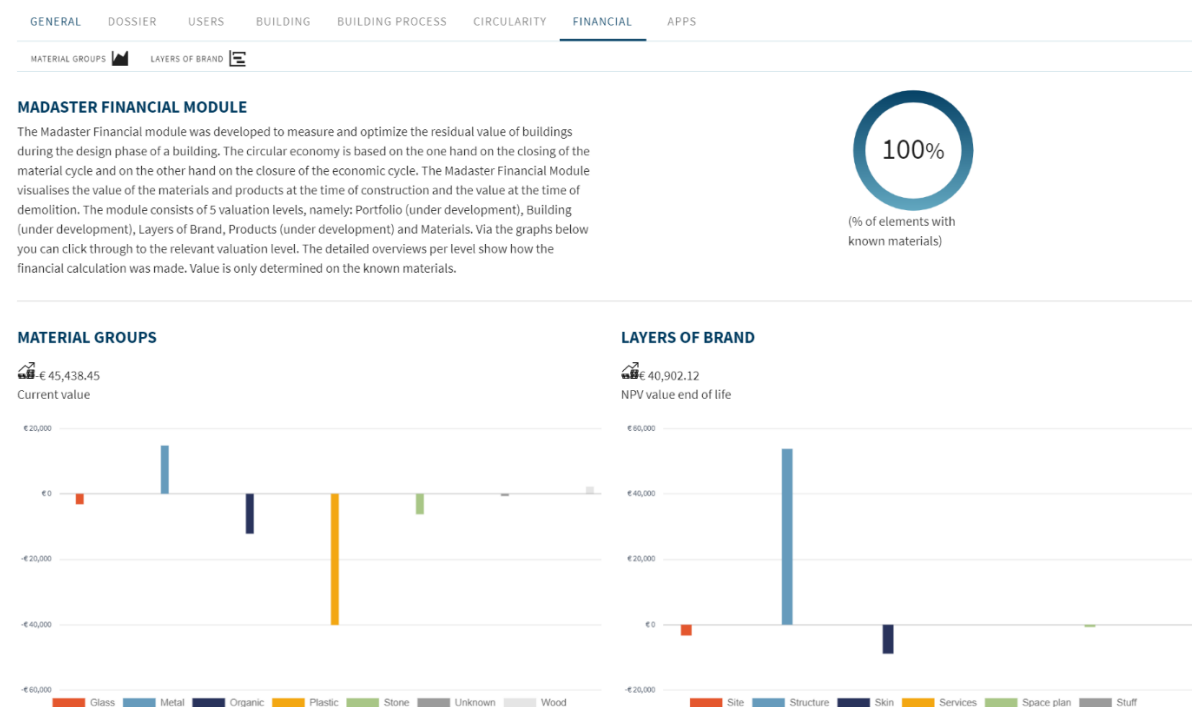
3.2.2 Correction factors

In development

4 Madaster Financial module

4.1 Start page

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4.1.1 What do I see

On the start page of the financial module, the top left corner contains a brief explanation of the financial tab and the different levels at which it was measured. On the top right is the percentage to which the model was correctly linked to the materials known on Madaster. Below is a dashboard showing the value of the different materials within the building and in which building layer this value is located. From the start page you can navigate to the detailed view: “material groups” and “building layers”.

4.1.2 What does it mean

Materials known

The round figure at the top right shows how many materials have been identified. Meaning: The proportion of volume of materials identified according to the materials on Madaster for the financial tab in relation to the total volume of materials in the building.

Material groups

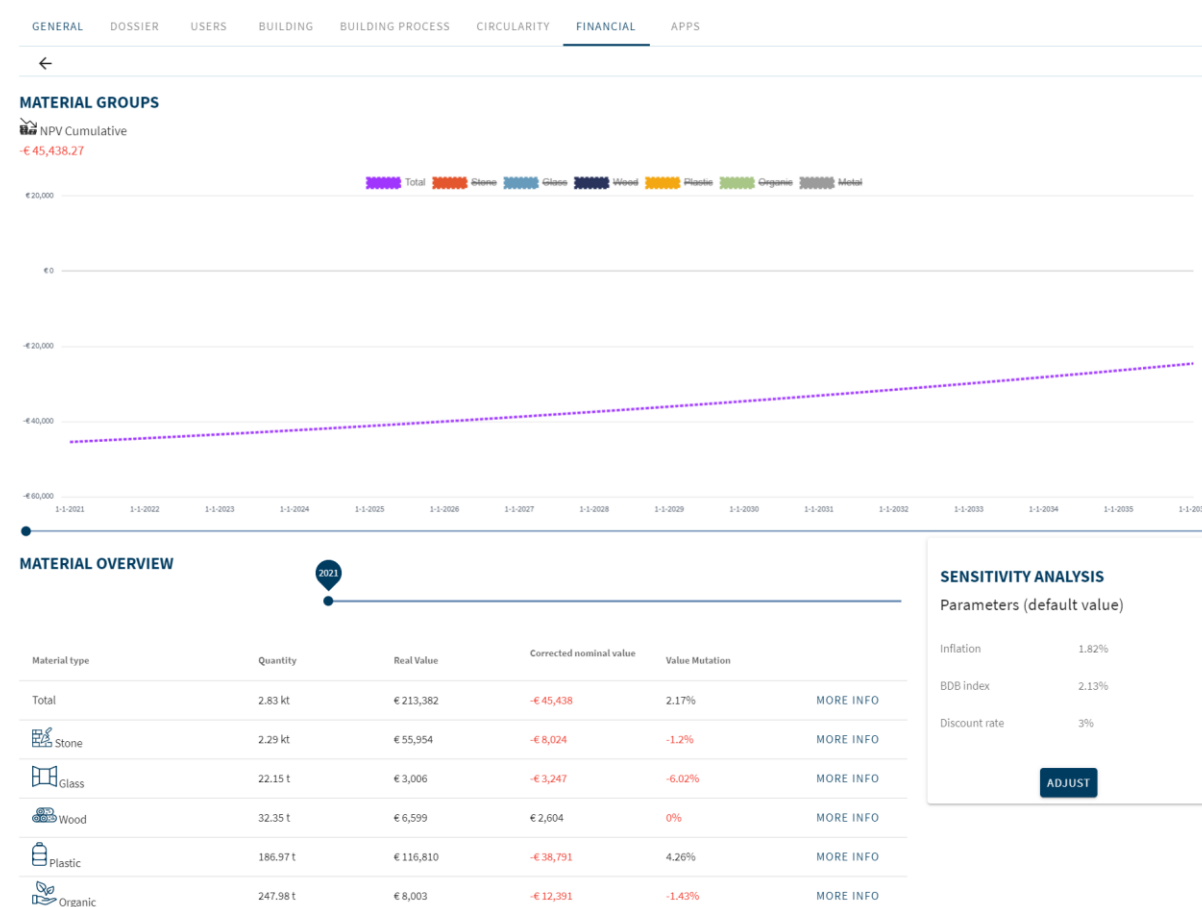
The chart on the lower left shows the value of the material groups. The value shown here is the current value of the materials. When hovering over the bars in the chart, the current value of the sum of materials in the respective material family appears.

Building layers

The bottom right graph shows the net present value of the various building layers based on functional life. The future value of the materials is calculated back to today using the discount rate which can be changed on the detail page.

4.2 Material groups

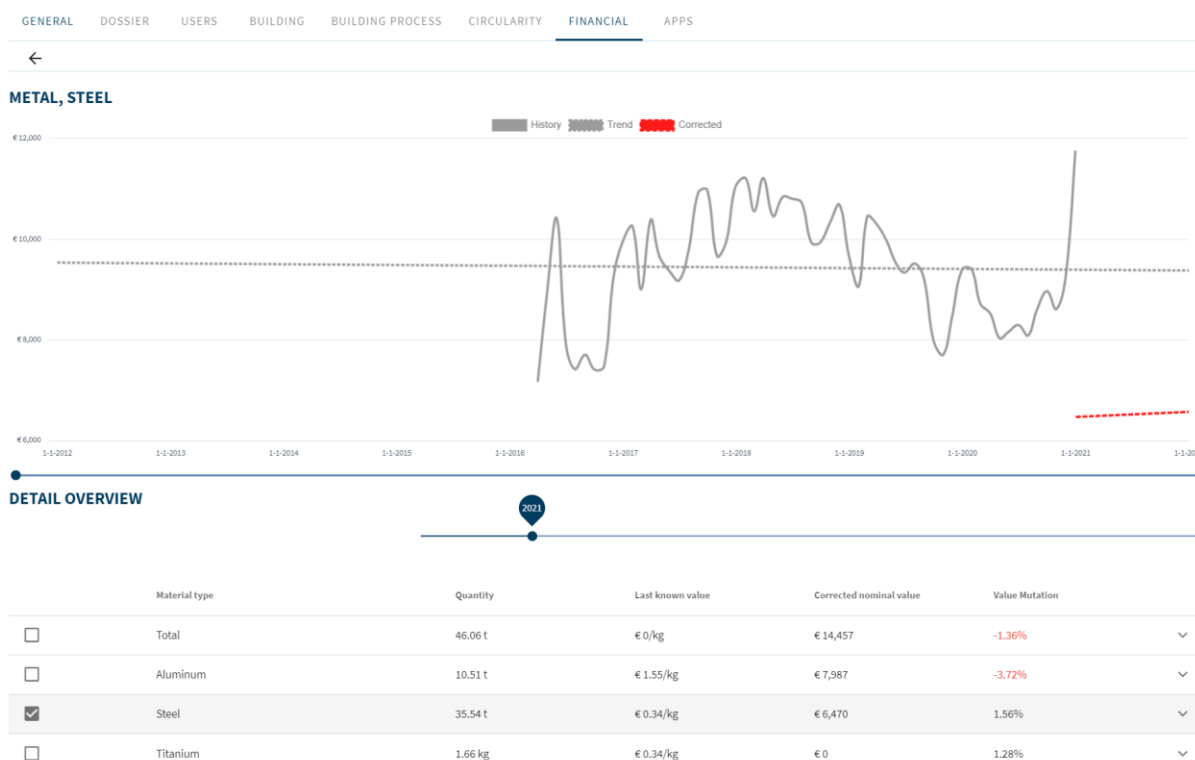
MADASTER GEBOUW: THE ARC



4.2.1 What do I see

The material groups page shows how the material value of material families develops over time. Above the graph, the various material families can be switched on and off by clicking on the respective group. The future value is calculated according to the formulas described in chapters 1, 2, and 3. This means that they are calculated on the basis of the historical value. Inflation is not included in the valuation towards the future. The future value is therefore the fair value of the materials. The column next to fair value shows the adjusted nominal value of the materials. This value does include inflation and the BDB index. In addition, the correction factors have already been deducted from the material value. This last value can be seen in the graph.

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4.2.2 How was this calculated

The value of the families of materials is determined by adding up the values of the materials within the families. The value of the materials is determined as described in chapter 2. When the “more info” button is clicked, a screen appears with further explanation of this value. The graph in the detailed view of a material family also shows the historical price series when a material is clicked on. This is shown as a solid line. A trend line is drawn through this, which is represented by a dotted line. The red dotted line is the corrected nominal value of the material. This has been corrected by the correction factors inflation and BDB index.

4.2.3 What does it mean

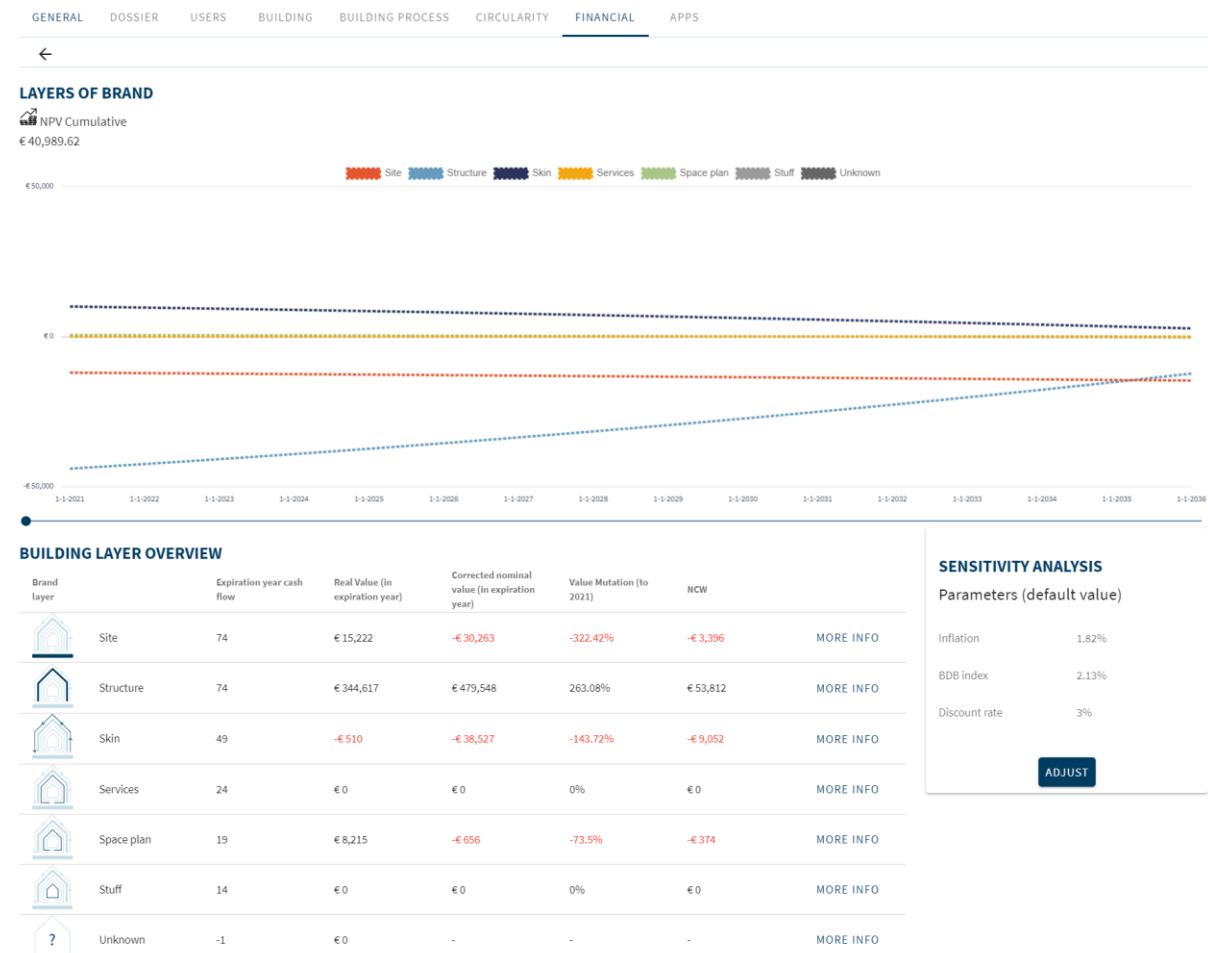
The total value of the product groups added together represents the material-level value for the entire building. The course of this value is shown in the graph. This does not yet include the discount rate. The value shown is the nominal value in the respective year.

4.3 Detailed view products

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4.4 Building layers

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4.4.1 What do I see

In the building layers page, the future value of materials at the end of their functional life was calculated. This is then discounted back to the present day using the discount rate. The assumptions for future value are, as described in chapter 2, based on historical price series which have been corrected with macro-economic effects by deduction of inflation and exchange rate.

4.4.2 How was this calculated

The net present value of a material flow with a given functional life is calculated by calculating the material value from $t = \text{functional life}$ back to $t = 0$. This is done according to the following formula:

$$NCW_{\text{materiaalstroom } x \text{ op } t=Lf} = \frac{NW_{\text{materiaal } x \text{ op } t=Lf}}{(1+d^t)}$$

Where:

$NCW_{\text{materiaalstroom } x \text{ op } t=Lf}$	Net present value of material flow x based on technical lifetime
$NW_{\text{materiaal } x \text{ op } t=Lf}$	The nominal value of material flow x at the end of its functional life
D	Discount rate
t	time

4.4.3 What does it mean

The different cash flows are put in time in this overview. That is, each material is removed from the building at the end of its functional life. From that year, the value of the material is calculated back with time effects calculated to $t = 0$. This results in the net present value of the various cash flows. The sum of these net present values is the net present value of the various material flows over the maintenance period of the building. This value could be decisive for the material choice and is the most important value in the investment decision.