

FAIRM QUICKSCAN

06-01-2021

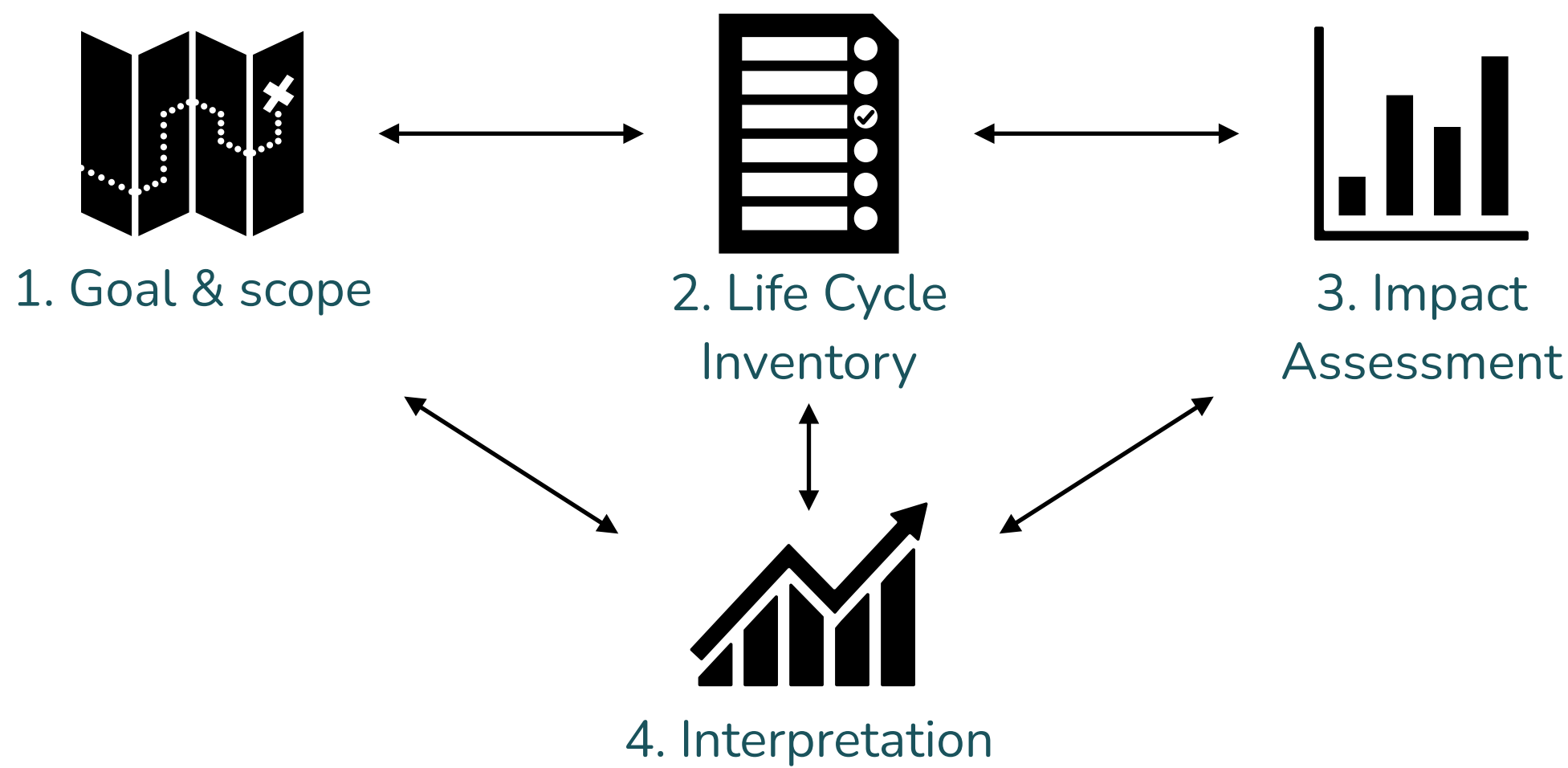


NEW ECONOMY



FAIRM QUICKSCAN

- Step 1. Digital site visit
- Step 2. Data collection
- Step 3. Data analysis
- Step 4. Presentation





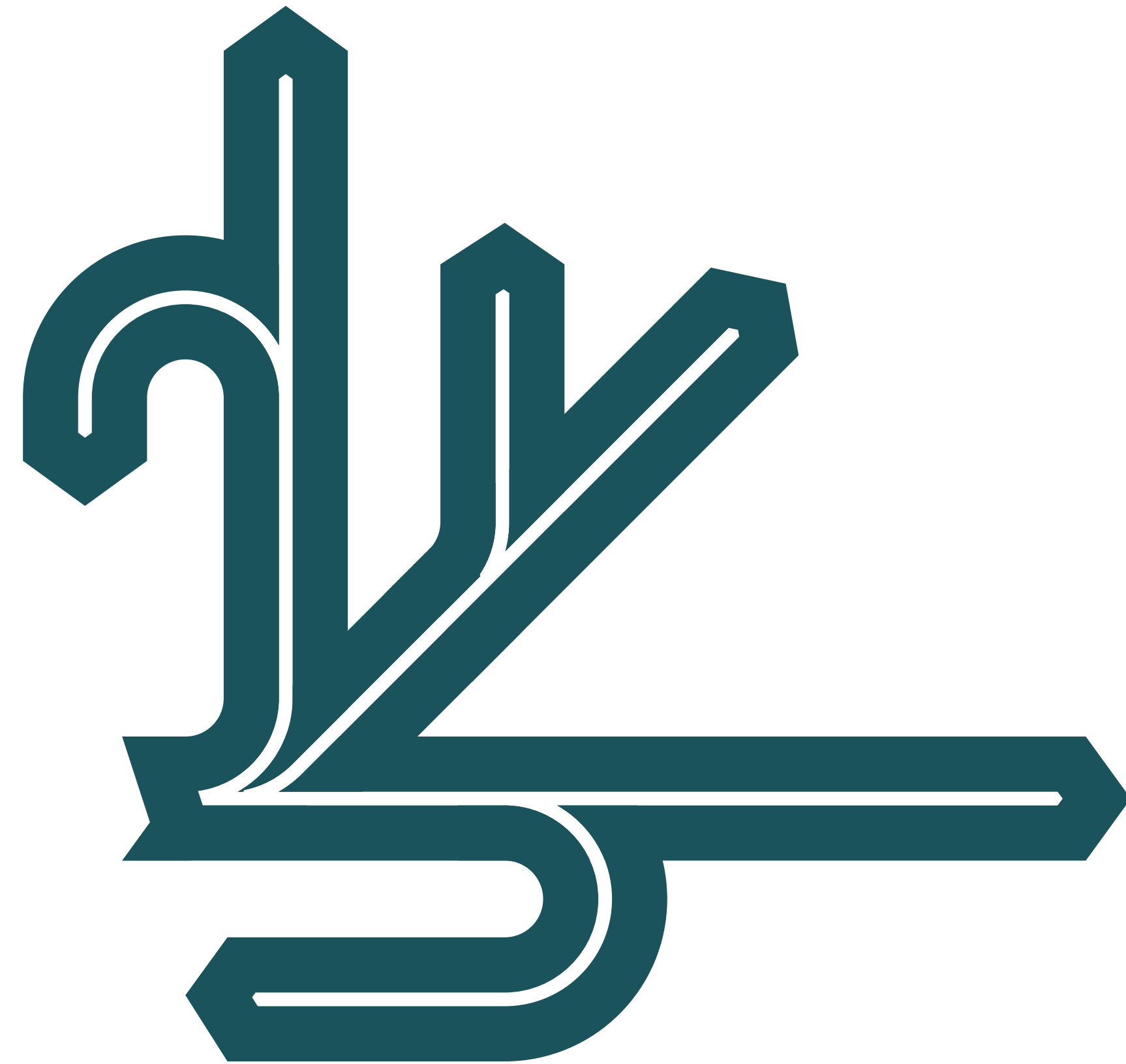
ONE INTRODUCTION

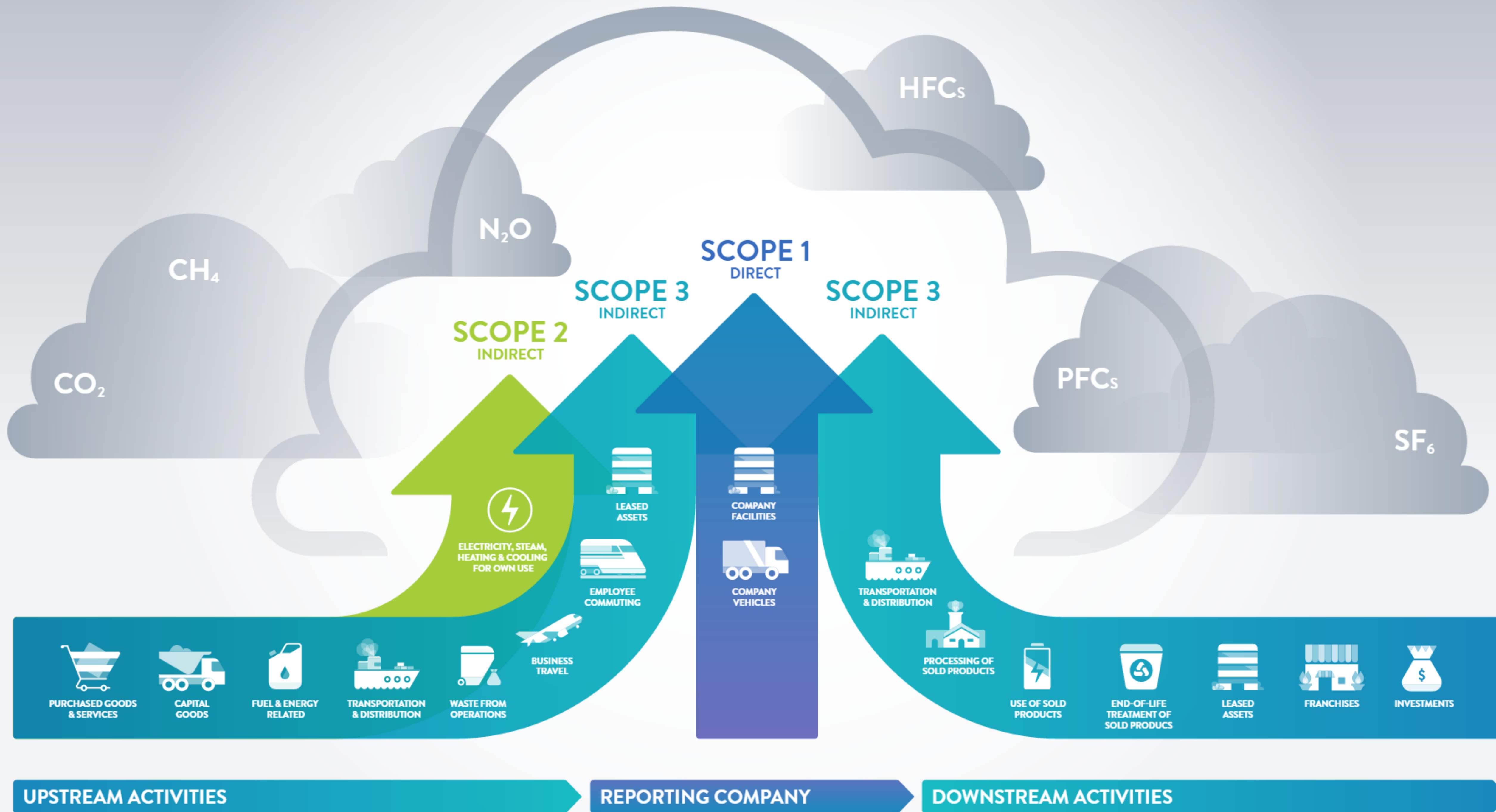
Pieces of the puzzle

Current recipe and material usage for mycelium production
Current streamlined process for mycelium insulation production
Density of end-product
Average mushroom farms for taking over production
Future possible machines to be used

In addition:

Desk research
Databases
Scientific literature





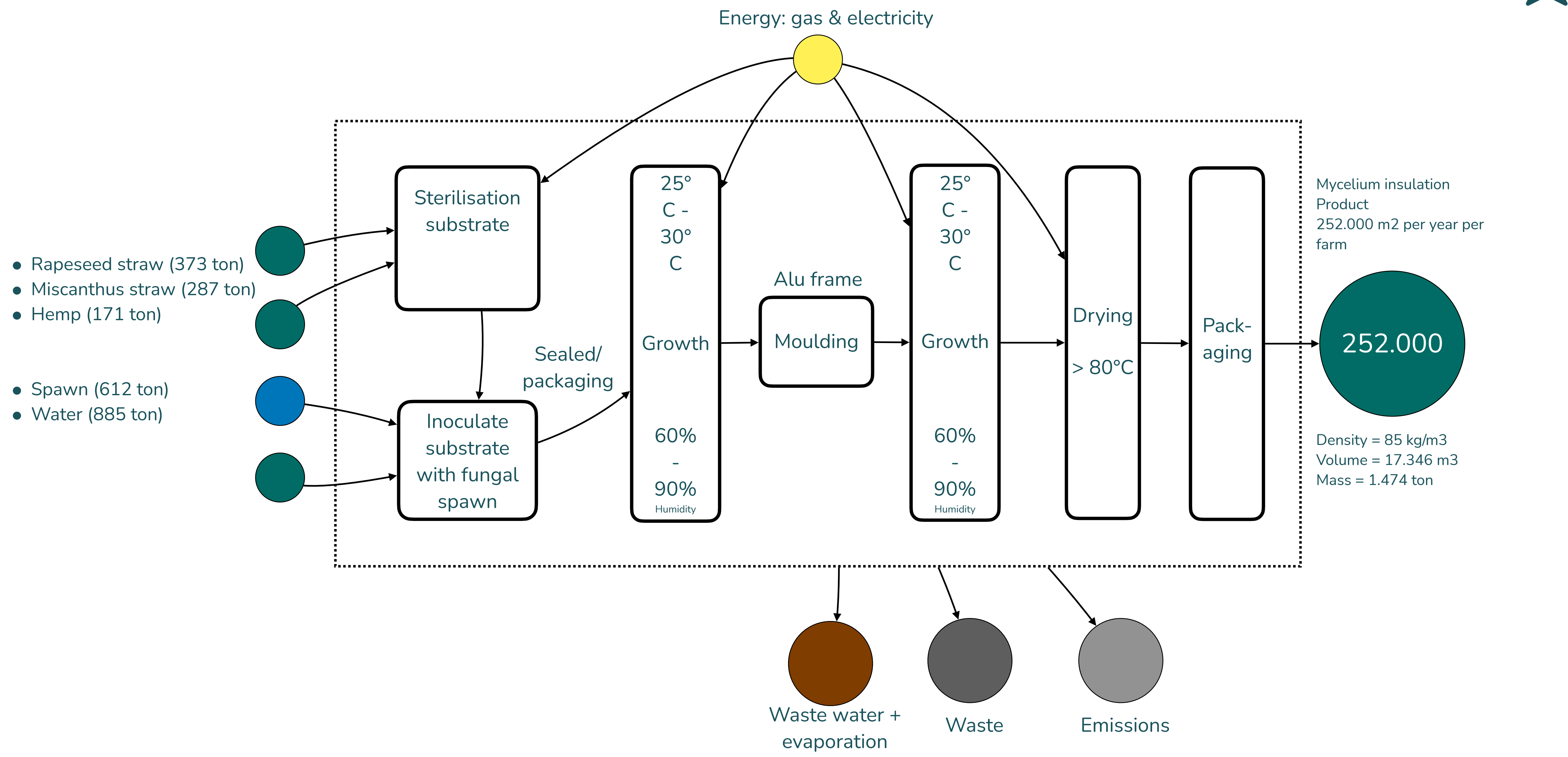


Figure 1. Schematic overview of FAIRM production process



	High	Medium	Low
Rapeseed straw	€ 74.501	€ 48.426	€ 11.175
Miscanthus straw	€ 2.868	€ 2.868	€ 2.868
Hemp	€ 6.829	€ 6.829	€ 6.829
Spawn	€ 226.494	€ 116.308	€ 12.243
Water	€ 77	€ 77	€ 77
Electricity usage	€ 217.764	€ 23.954	€ 4.791
Gas (sterilisation)	€ 386.128	€ 96.532	€ 28.960
Gas (climate control)	€ 1.050.269	€ 262.567	€ 78.770
Gas (drying)	€ 34.144	€ 8.536	€ 4.268
Cardboard corners	€ 1.320	€ 1.320	€ 1.320
LDPE plastic wrapping	€ 532	€ 532	€ 532
Plastic liner (non-agricultural) LDPE	€ 0	€ 0	€ 875
Trucks	€ 3.673	€ 3.673	€ 3.673

Table 1. Impact in Ecocosts (MKI) for high, medium and low Fairm farm scenario

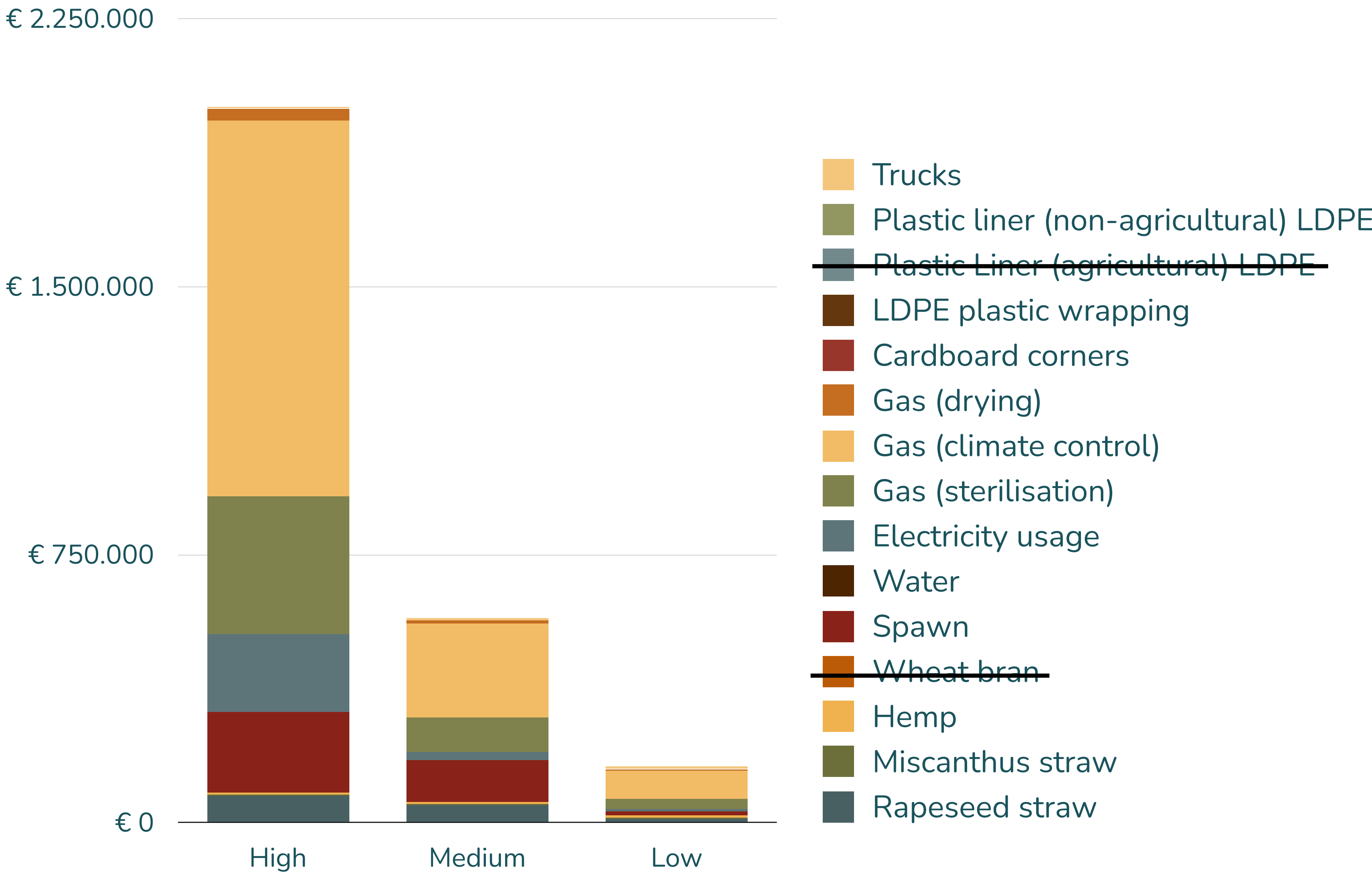


Figure 2. Impact in Ecocosts (MKI) for high, medium and low Fairm farm scenario (per year)



	High	Medium	Low
Rapeseed straw	€ 74.501	€ 48.426	€ 11.175
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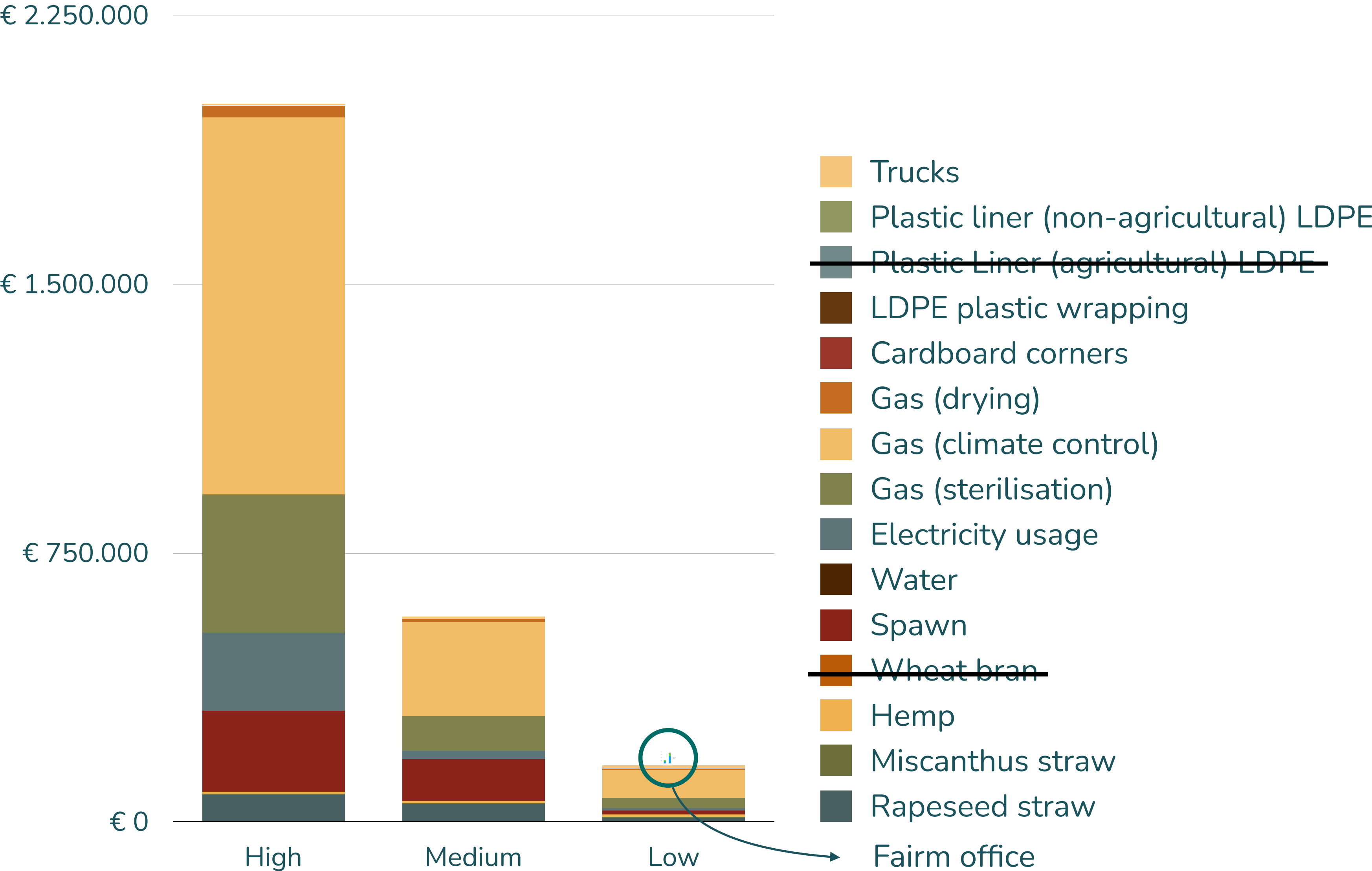


Figure 2. Impact in Ecocosts (MKI) for high, medium and low Fairm farm scenario (per year)



TWO MATERIALS

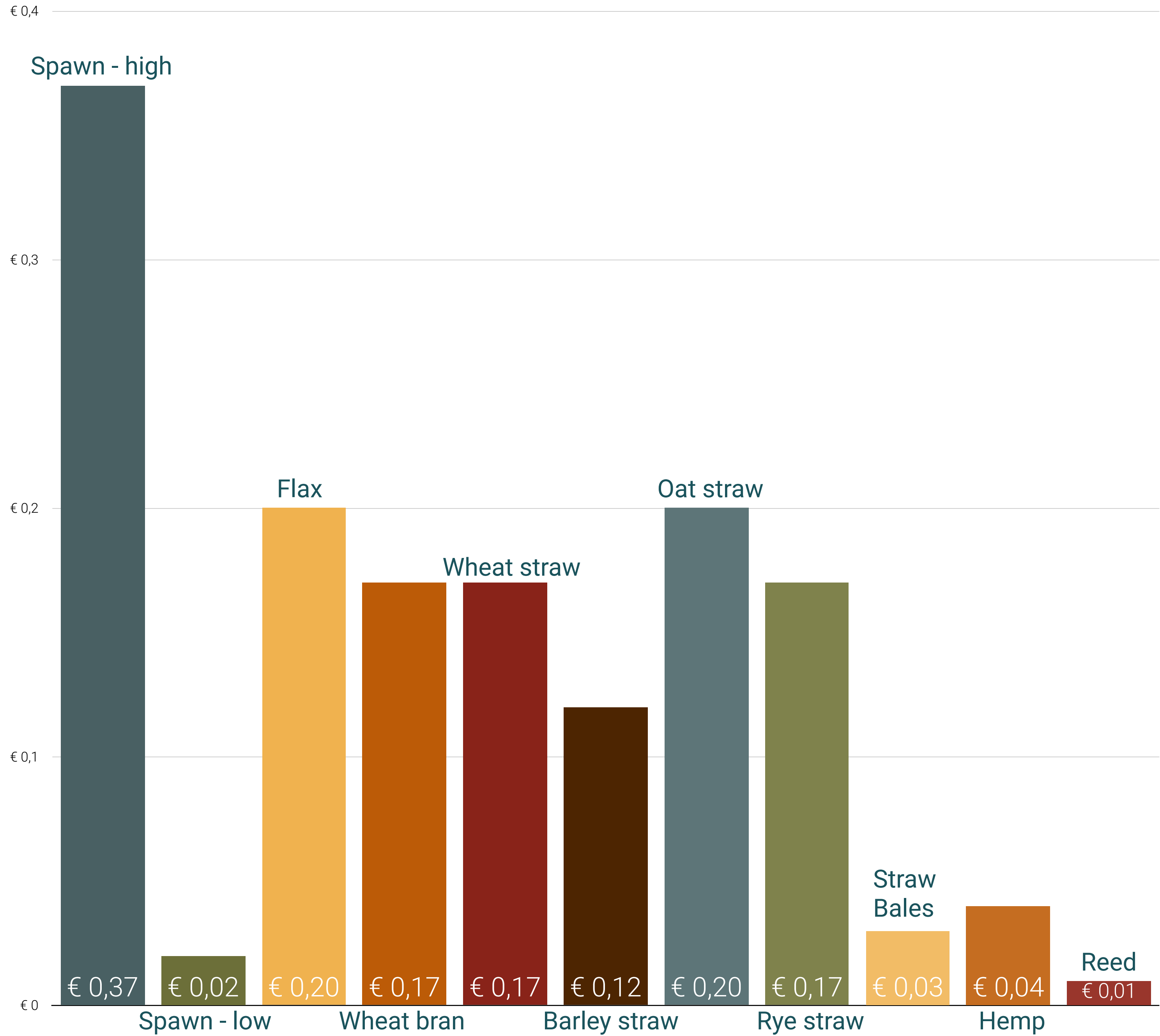


Figure 3. Impact in Ecocosts (MKI) for potential input materials (per kg)



Impact of 1 Kg wheat production = 100 €

	Economic	Mass	Energy	Functional unit
Head & Kernel	€ 95	€ 10	€ 30	€ 88
Leaves	€ 2	€ 20	€ 10	€ 2
Stem	€ 3	€ 70	€ 60	€ 10

Table 2. (Hypothetical) Impact allocation of byproducts LCA

€95,-
10 Kg
30 MJ
88 gr protein

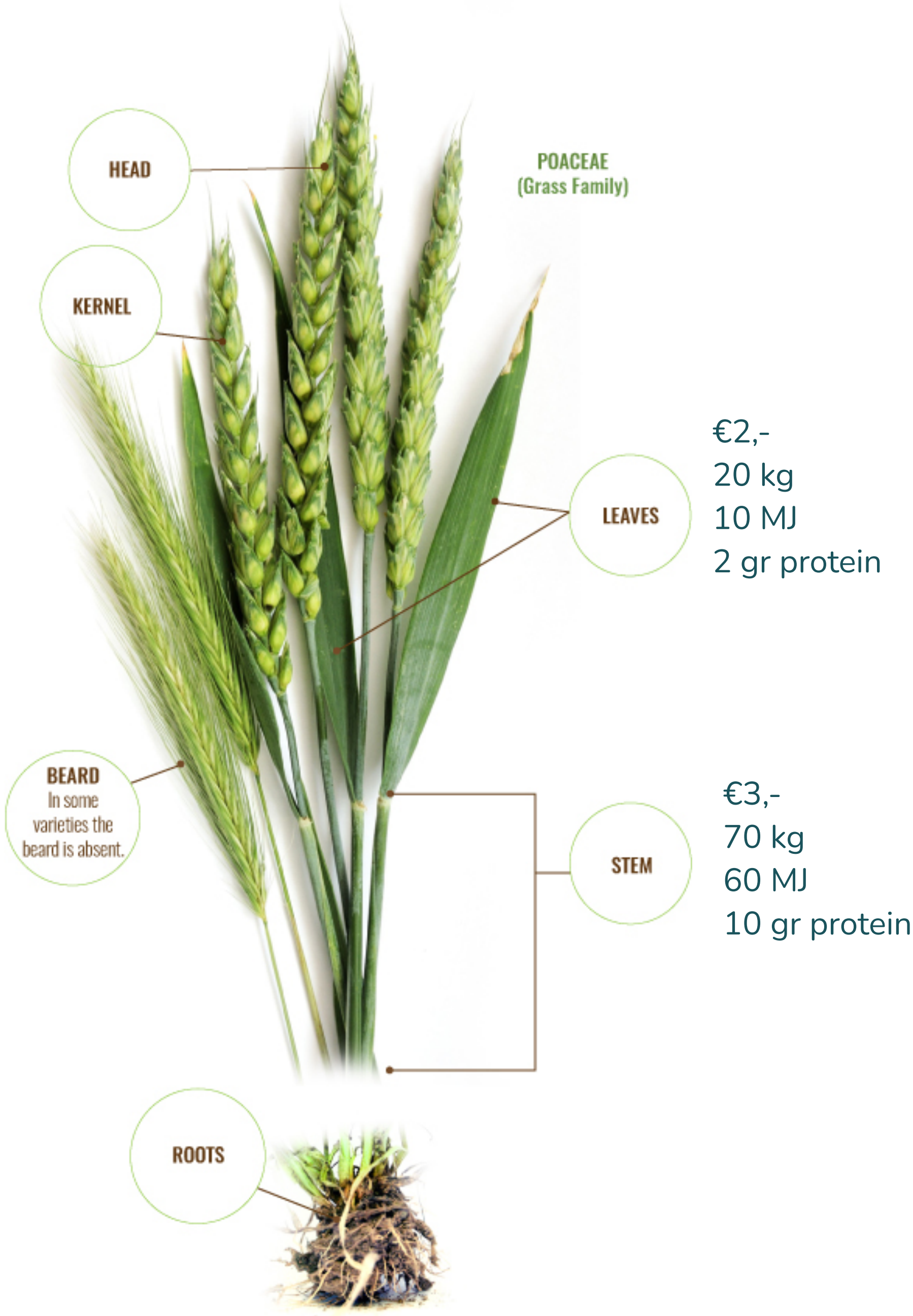


Figure 4. (Hypothetical) Impact allocation of byproducts LCA

Input materials - total ecocosts mycelium production

Material type	Consumption mass (kg)	Impact high	Impact medium	Impact low
Rapeseed straw	372.505	€ 74.501	€ 48.426	€ 11.175
Miscanthus straw	286.826	€ 2.868	€ 2.868	€ 2.868
Hemp	170.722	€ 6.829	€ 6.829	€ 6.829
Spawn	612.146	€ 226.494	€ 116.308	€ 12.243
Water	884.667	€ 77	€ 77	€ 77

Tabel 3. Input materials (kg) and total impact in ecocosts

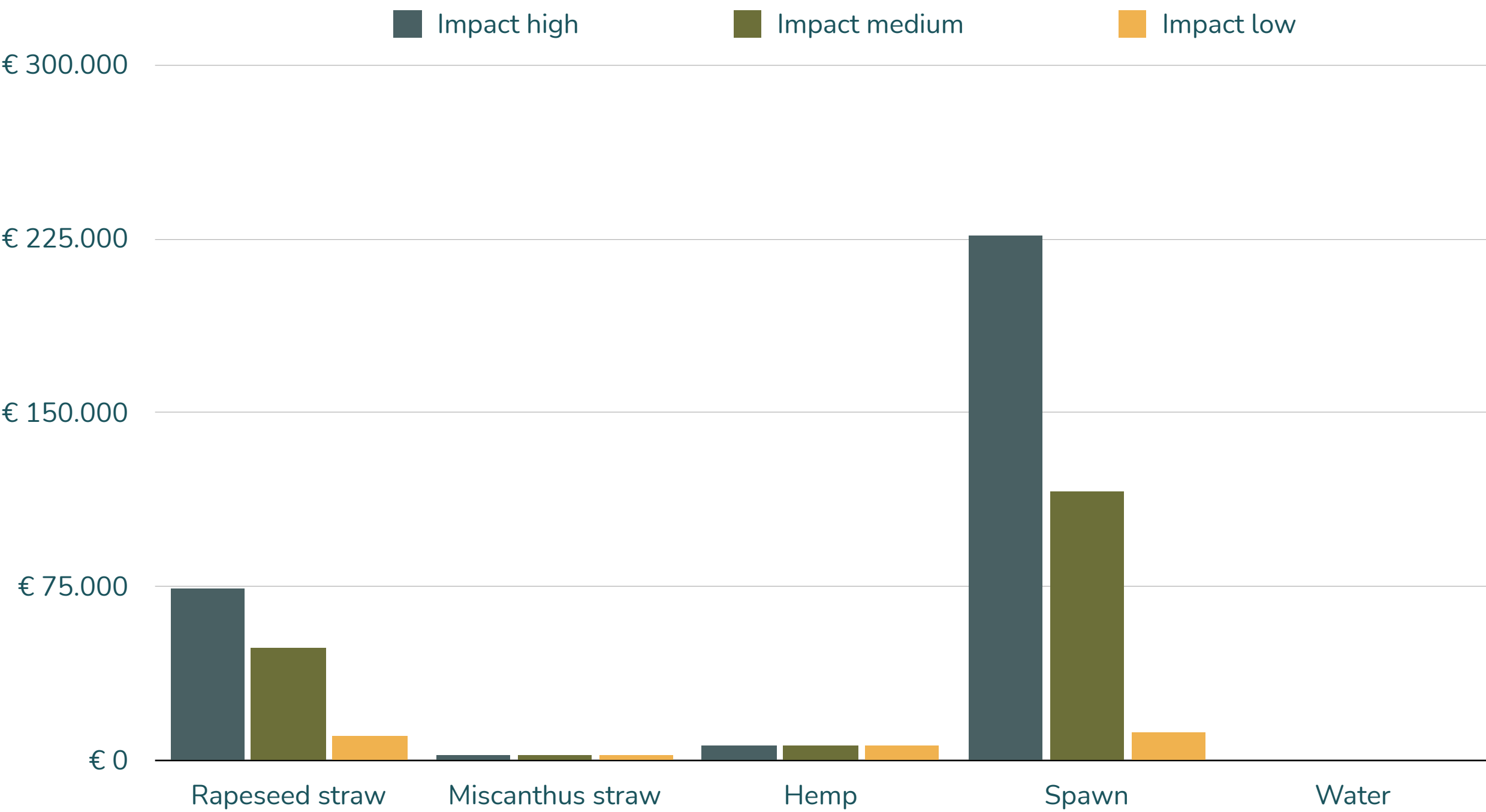


Figure 4. Total ecocosts of input materials for Fairm production (high, medium & low scenario)



THREE ENERGY



Overview Energy Mycelium production

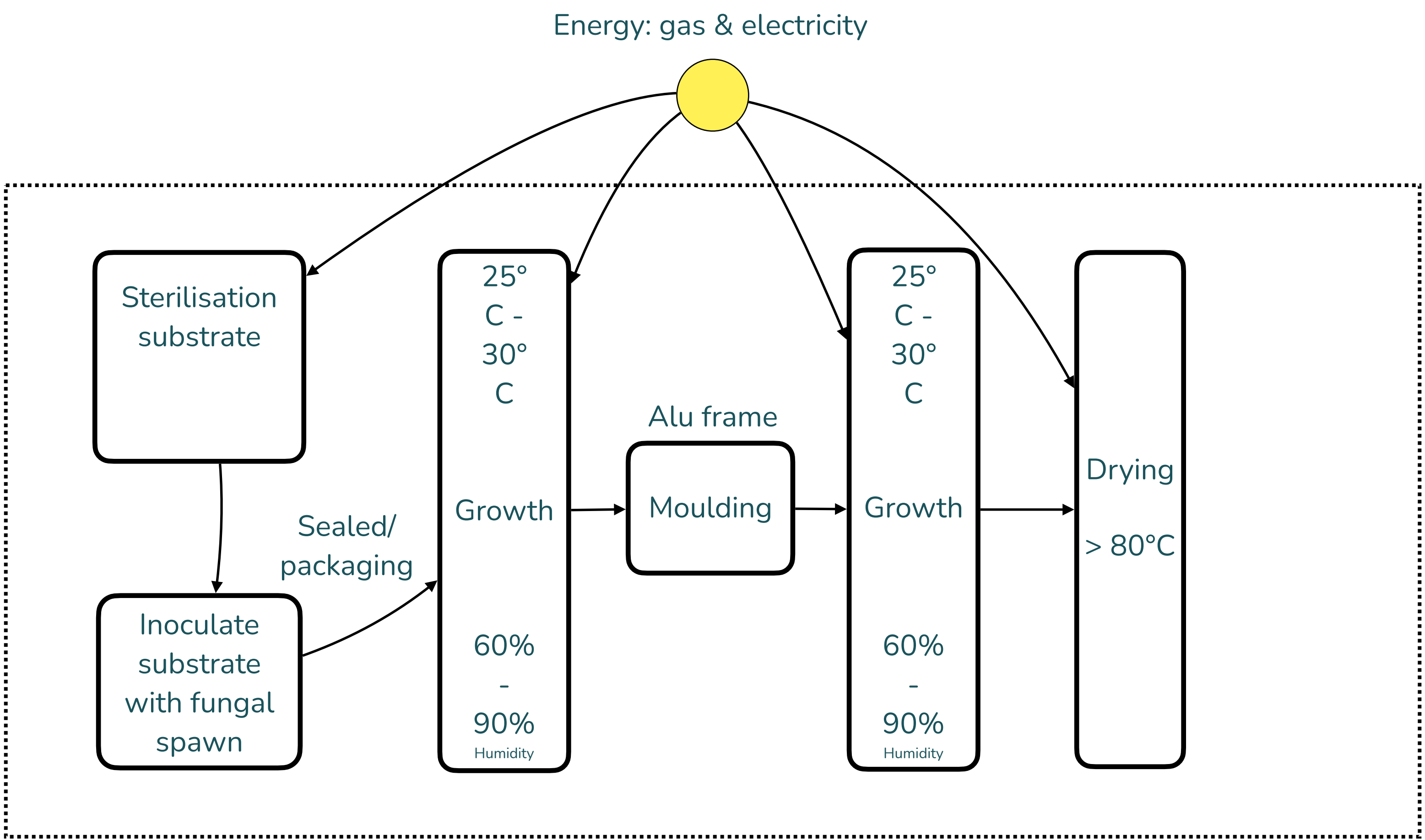


Figure 5. Schematic overview of Fairm production process



Sterilisation substrate mycelium

Gas usage p/m2/cycle (25% of 4m3)	1
Amount of cycles per year	51
Production m2/cell/cycle	353
Production m2/y/cell	18.003
Amount of cells	14
Production m2/y	252.042
Gas usage total p/y p farm (sterilisation) (m3)	252.042

Table 4. Energy usage sterilisation substrate

Onderzoek naar het energiezuinig paddenstoelenbedrijf anno 2010;

hoogst haalbare niveau van energiereductie en energie-efficiency.

• Oppervlakte teelt:	15 teeltcellen x 1350 m ² = 20.250 m ²
• Teelt m ² per jaar	210.600
• Type teelt:	Machinale oogst
• Soort paddenstoel:	Witte champignon
• Gasverbruik op jaarbasis:	Gas 4,0 m ³ /m ² /teelt = 842.400 m ³
- Verwarmen:	68%
- Stomen (doodstomen):	25%
- Bevochtigen (stomen):	7%
• Elektriciteitsverbruik op jaarbasis:	Elektriciteit 8,0 kWh/m ² /teelt = 1.684.800 kWh
- Koeling:	57%
- Ventilatie/klimaatregeling:	28%
- Overig:	15%



Climate control

Production m2/y	252.042
General heating (gas) m3/m2	2,72
Gas usage total p/y p farm (m3) (climate control)	685.554
Electricity requirements kWh/m2	8
Electricity usage total p/y p farm (kWh)	2.016.336

Table 5. Energy usage climate control

• Oppervlakte teelt: • Teelt m² per jaar • Type teelt: • Soort paddenstoel: • Gasverbruik op jaarbasis: - Verwarmen: 68% - Stomen (doodstomen): 25% - Bevochtigen (stomen): 7% • Elektriciteitsverbruik op jaarbasis: - Koeling: 57% - Ventilatie/klimaatregeling: 28% - Overig: 15%	15 teeltcellen x 1350 m² = 20.250 m² 210.600 Machinale oogst Witte champignon Gas 4,0 m³/m²/teelt = 842.400 m³ Elektriciteit 8,0 kWh/m²/teelt = 1.684.800 kWh
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Drying

Energy requirement to remove 0,60 ton water (GJ) <i>Kiln drying method</i>	0,988
Water quantity in total production ton/y	885
Total energy requirement (GJ)	874
1 GJ energy equals (m3) gas	25,5
Gas requirements for drying (m3)	22.287

Table 6. Energy usage drying



Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 56 (2013) 650 – 655

Procedia Engineering

www.elsevier.com/locate/procedia

5th BSME International Conference on Thermal Engineering

Techno-economic and environmental evaluation of biomass dryer

Nawshad Haque and Michael Somerville

CSIRO Minerals Down Under Flagship, Bag 312, Clayton South, Victoria 3168, Australia

3.5. Energy and CO₂ emission from biomass drying

Drying thermal energy has been calculated based on 1.64 GJ/t of water removed from biomass at 95°C, as predicted by the drying model. About 0.68 t of water needs to be removed to produce a tonne of oven-dry biomass, if the initial moisture content is 68% (dry-basis). The thermal energy requirement was calculated to be 1.12 GJ/t oven-dry biomass. Drying thermal energy is assumed to be sourced from burning woody waste with 85% boiler efficiency. For obtaining 1.32 GJ thermal energy, 81 kg of wood waste is used as fuel. Wood has specific energy of 16.2 GJ/t. The emission factor for wood combustion is calculated to be 20.7 kg CO₂-e/t dry wood [11]. Thus emission from drying thermal energy using waste wood as a fuel is 1.69 kg CO₂-e/t of oven-dry biomass. Similarly, the factors can be estimated based on other fuels used for energy in drying.



Overview energy

		MJ
Electricity usage total p/y p farm (kWh) (climate control)	2.016.336	7.258.810
Gas usage total p/y p farm (m3) (sterilisation)	252.042	9.653.209
Gas usage total p/y p farm (m3) (climate control)	685.554	26.256.718
Gas usage total p/y p farm (m3) (drying)	22.287	853.592

Table 7. Energy usage overview

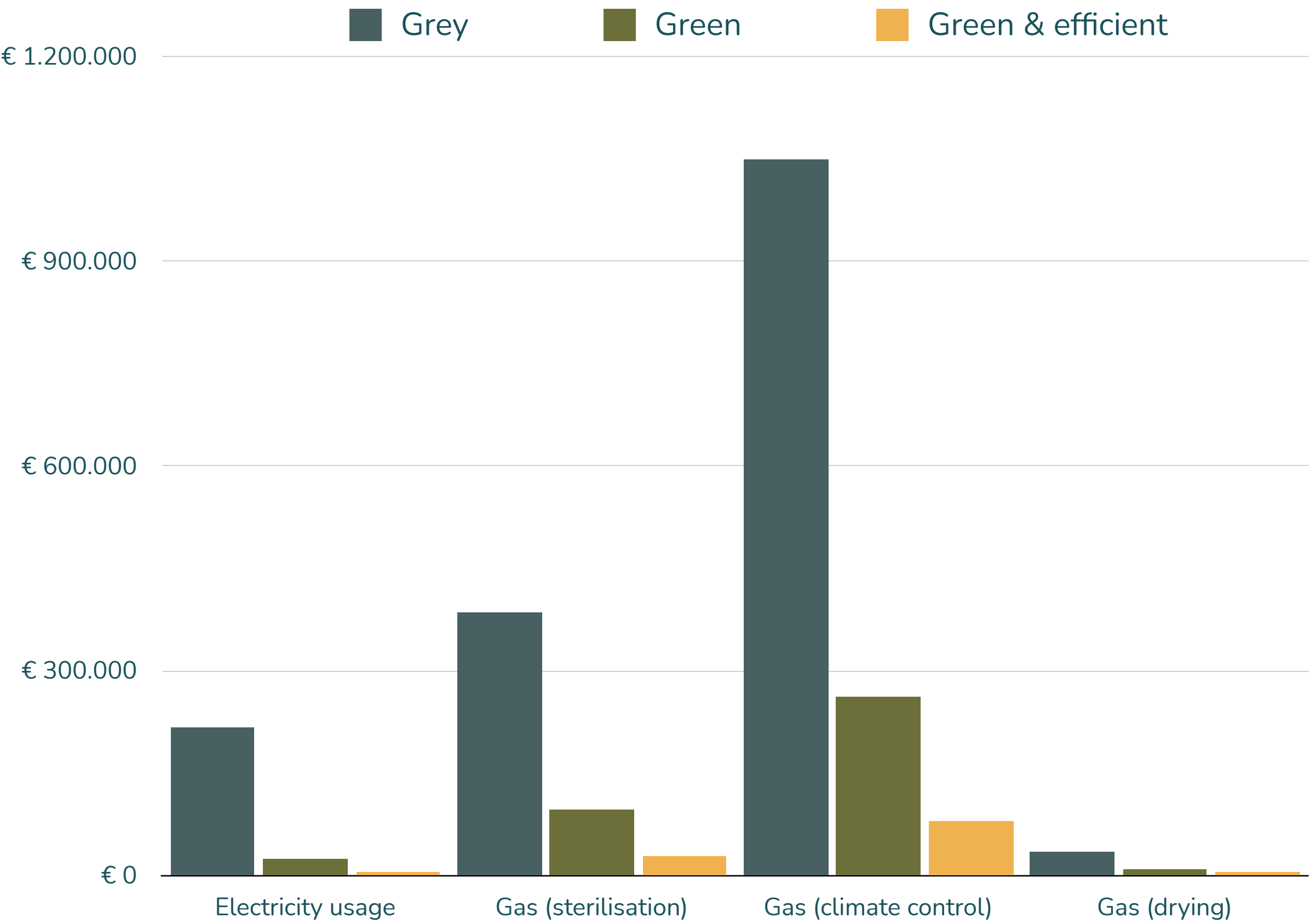


Figure 6. Ecocosts of total energy usage (high, medium & low scenario)



FOUR

PACKAGING



Packaging

	Mass (kg)	Impact high	Impact medium	Impact low
Cardboard corners	7.809	€ 1.319,74	€ 1.319,74	€ 1.319,74
LDPE plastic wrapping	2.156	€ 531,95	€ 531,95	€ 531,95
Plastic liner (non-agricultural) LDPE	3.548			€ 875,00

Table 8. Total ecocosts of packaging materials

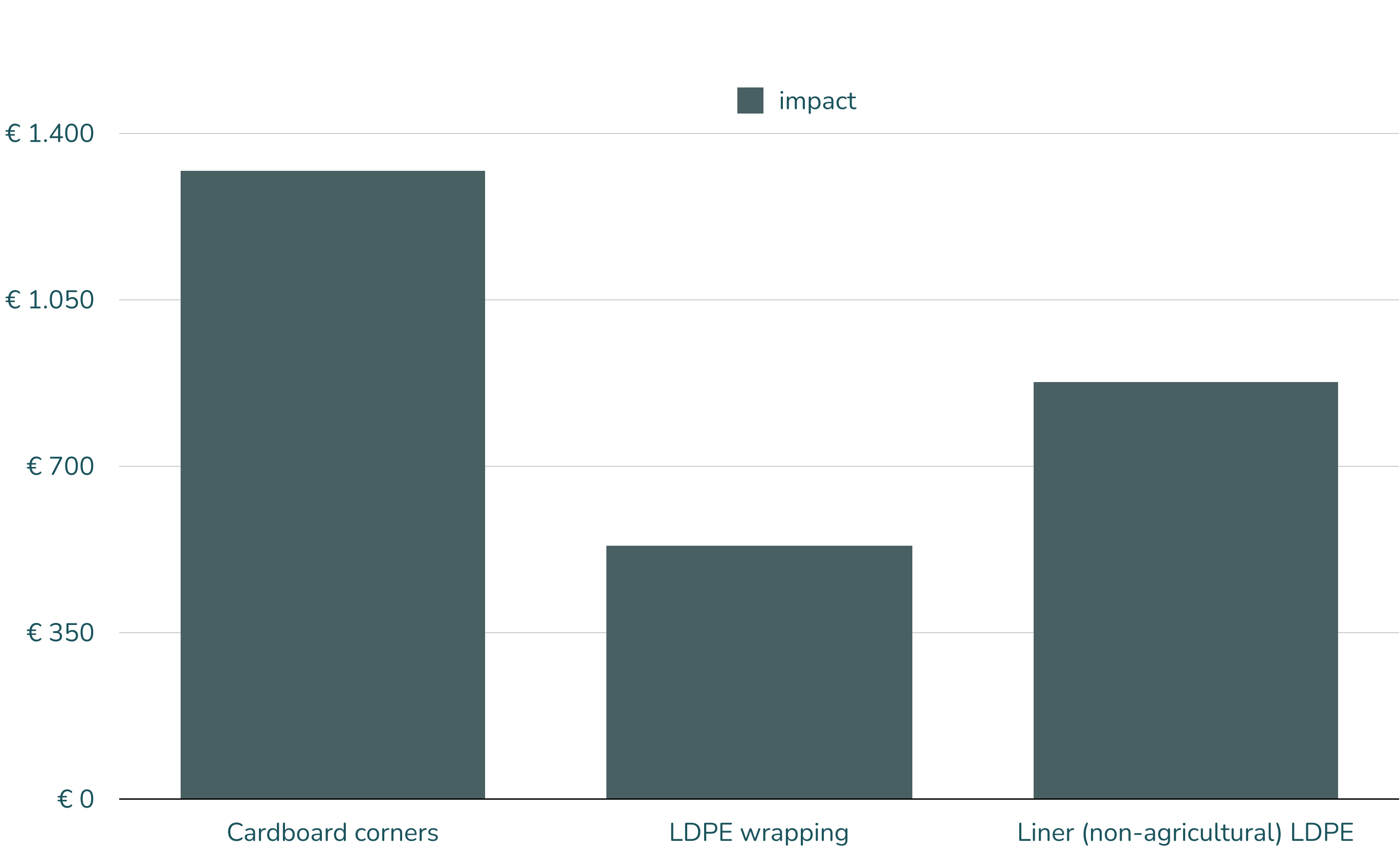


Figure 7. Ecocosts of packaging materials (total production)



FIVE OVERVIEW

5. OVERVIEW

	High	Medium	Low
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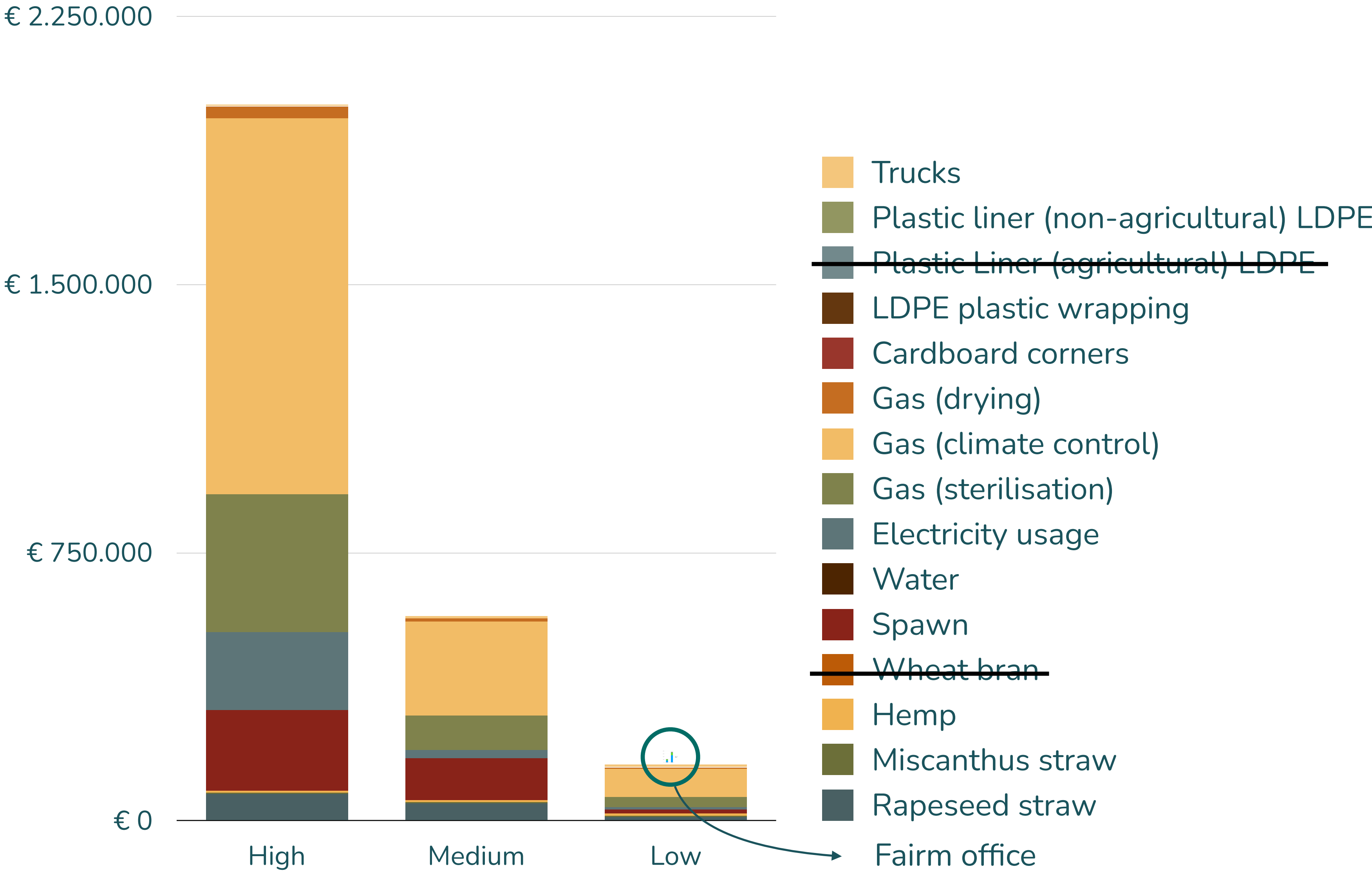
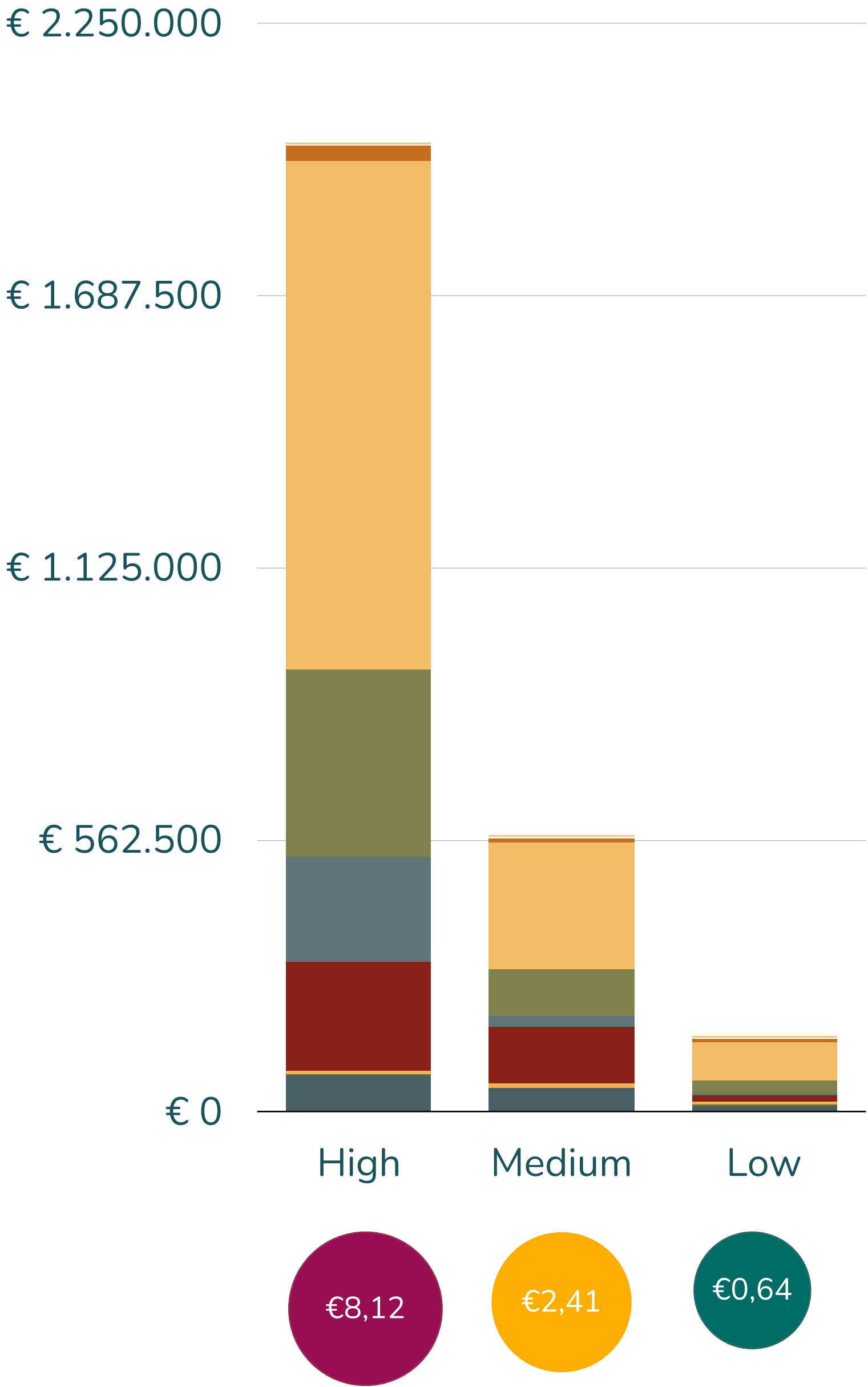


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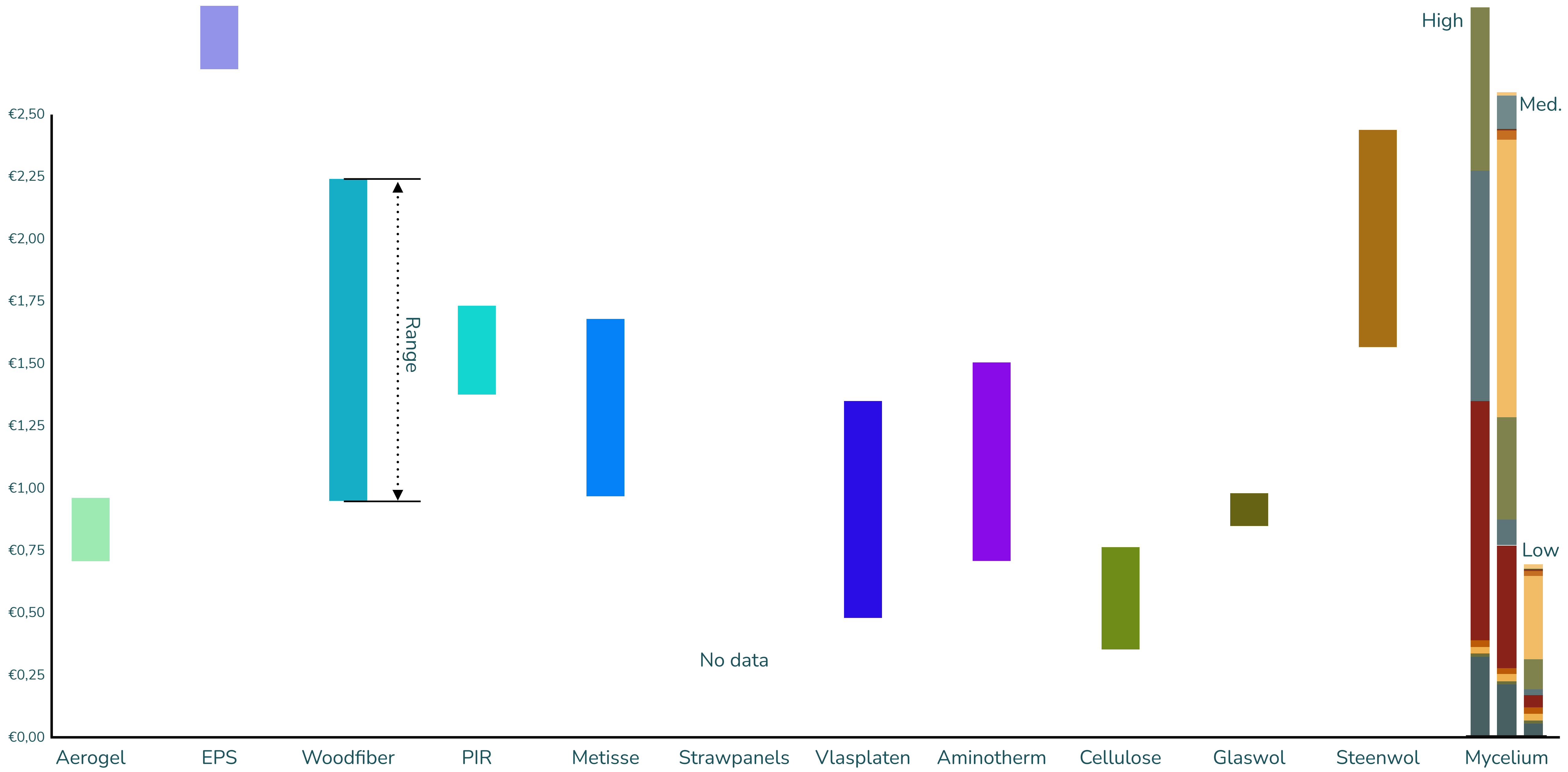


Mycelium insulation
Product
252.000 m2 per year
per farm



Density = 85 kg/m3
Volume = 17.346 m3
Mass = 1.474 ton

Figure 8. Impact in Ecocosts (MKI) per m2



ECOCOSTS RANGE PER M2 (DATA FROM: SPAAKCS & NEW ECONOMY, 2021)

FIGURE 9.



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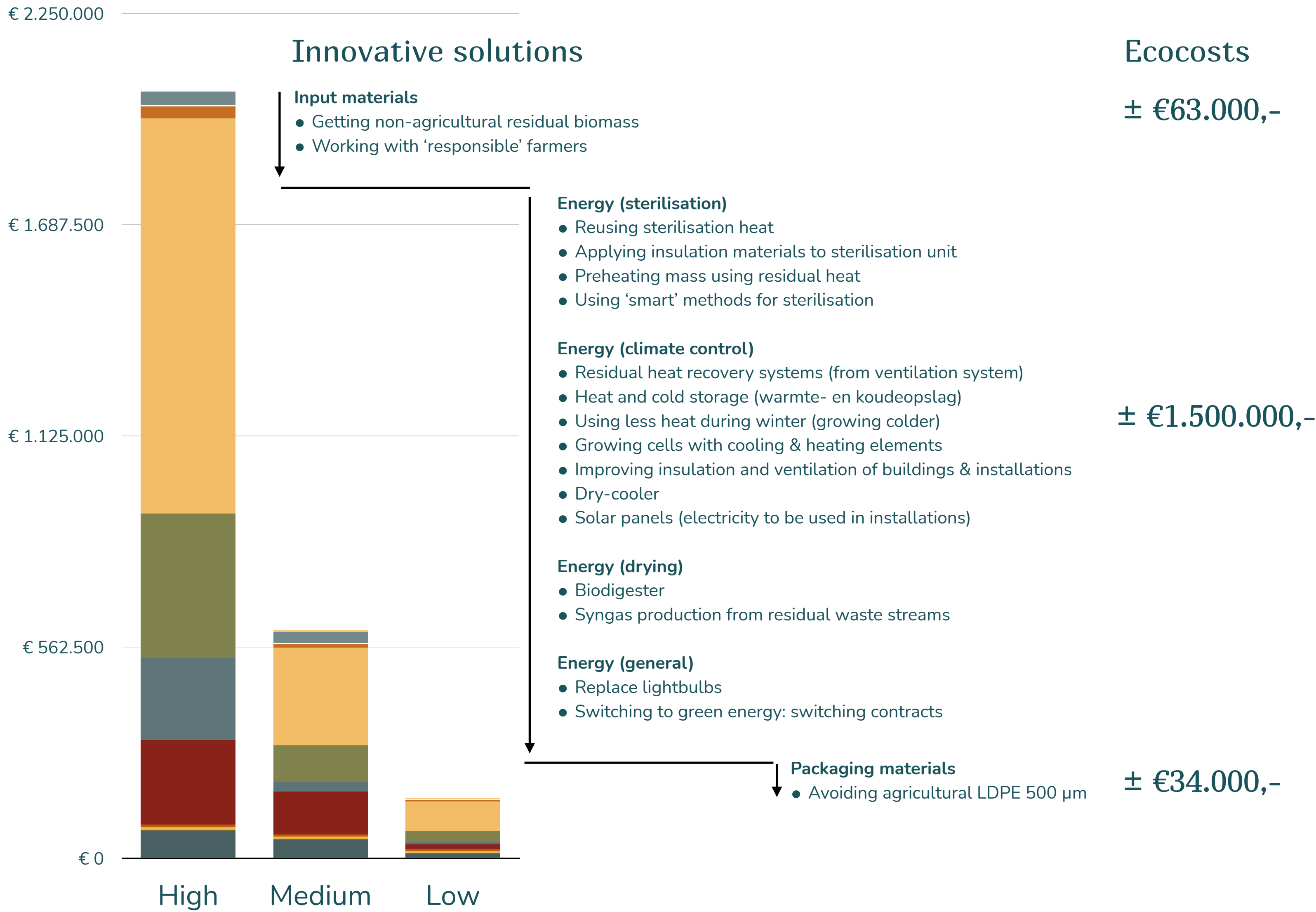


Figure 2. Impact in Ecocosts (MKI) for high, medium and low Fairm farm scenario



SIX STRATEGY



What do you wake up for in the morning?

Direction A: The greenest mycelium insulation

Materials

- Checklist responsible source materials
 - Local, non-agricultural, responsible agricultural

Energy

- Checklist collaboration with 'potential' mushroom farms
 - Energy efficient, energy neutral, green

Packaging & transportation

- Checklist responsible source materials
 - Agricultural liner, reuse or refuse



Direction B: Maximising positive impact

Using biobased knowledge in supply chain (R&D)

- Reducing 'pollutants' from agri-streams
 - Example: biobased replacements for plastic strings
- Developing energy efficient systems
 - Example: Efficient drying technology

Exploring alternative markets

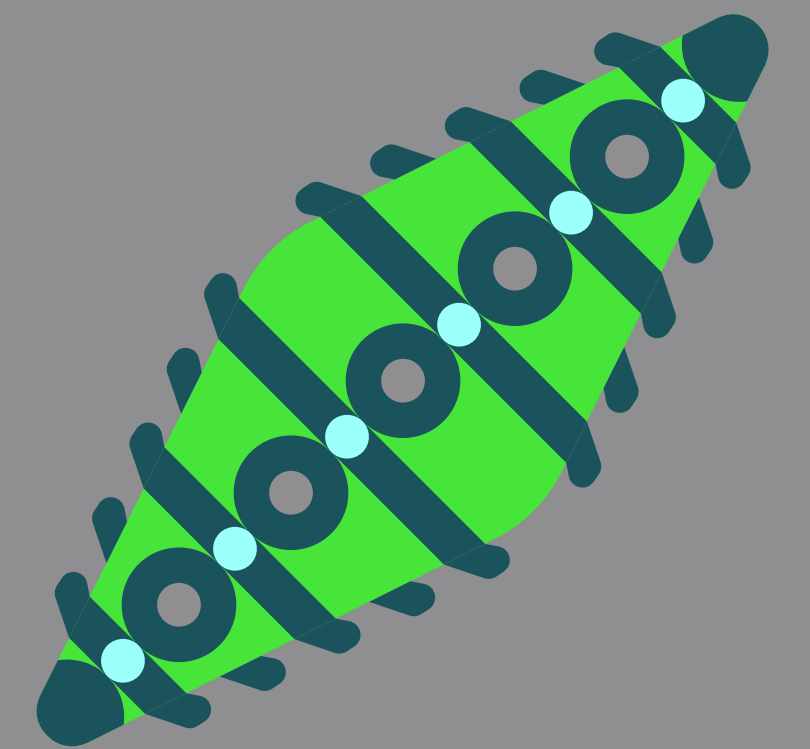
- Value proposition of material properties mycelium
 - Example: Aerospace technologies

Strategic partnerships

- Find the right partners to develop the above



THANK YOU

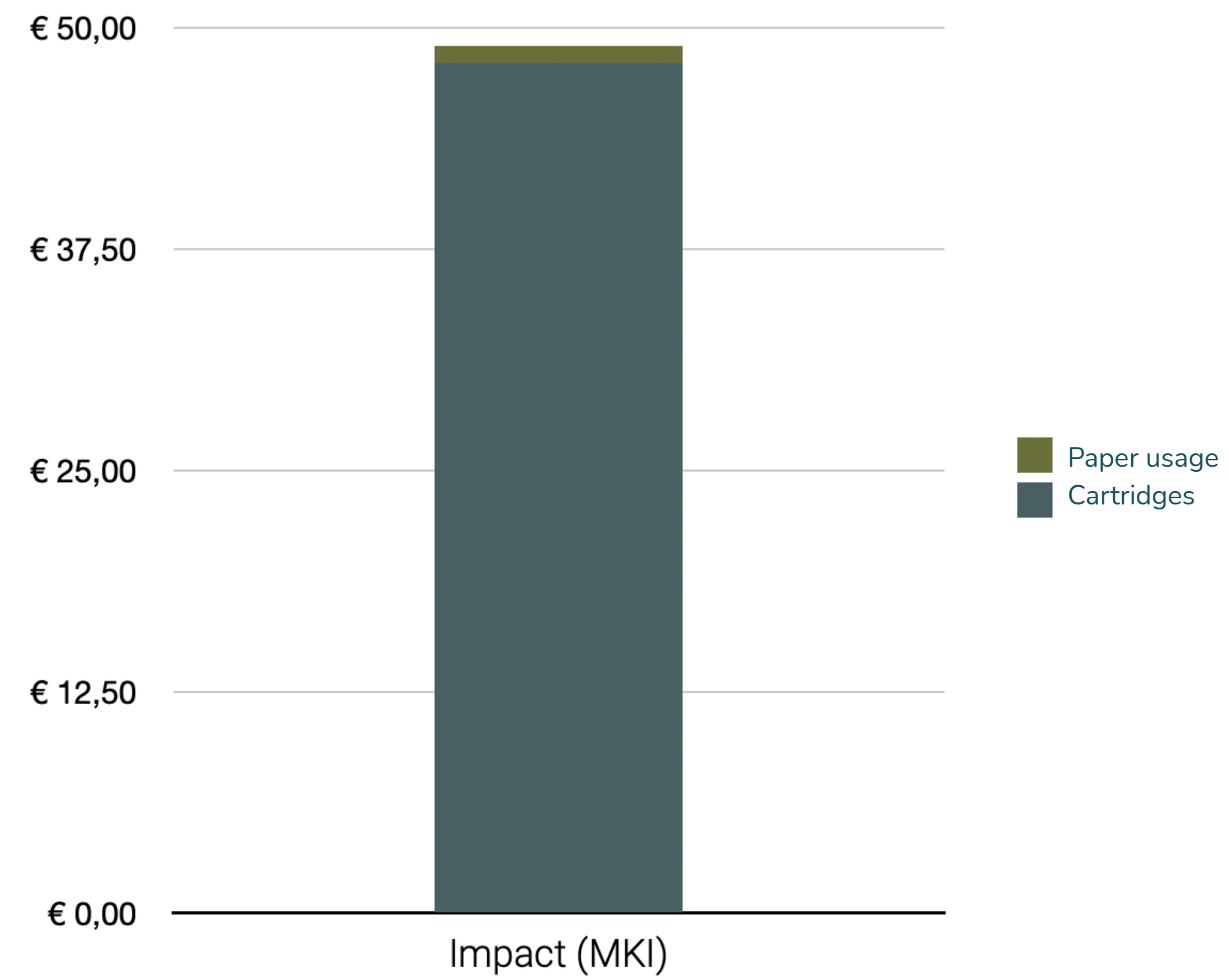




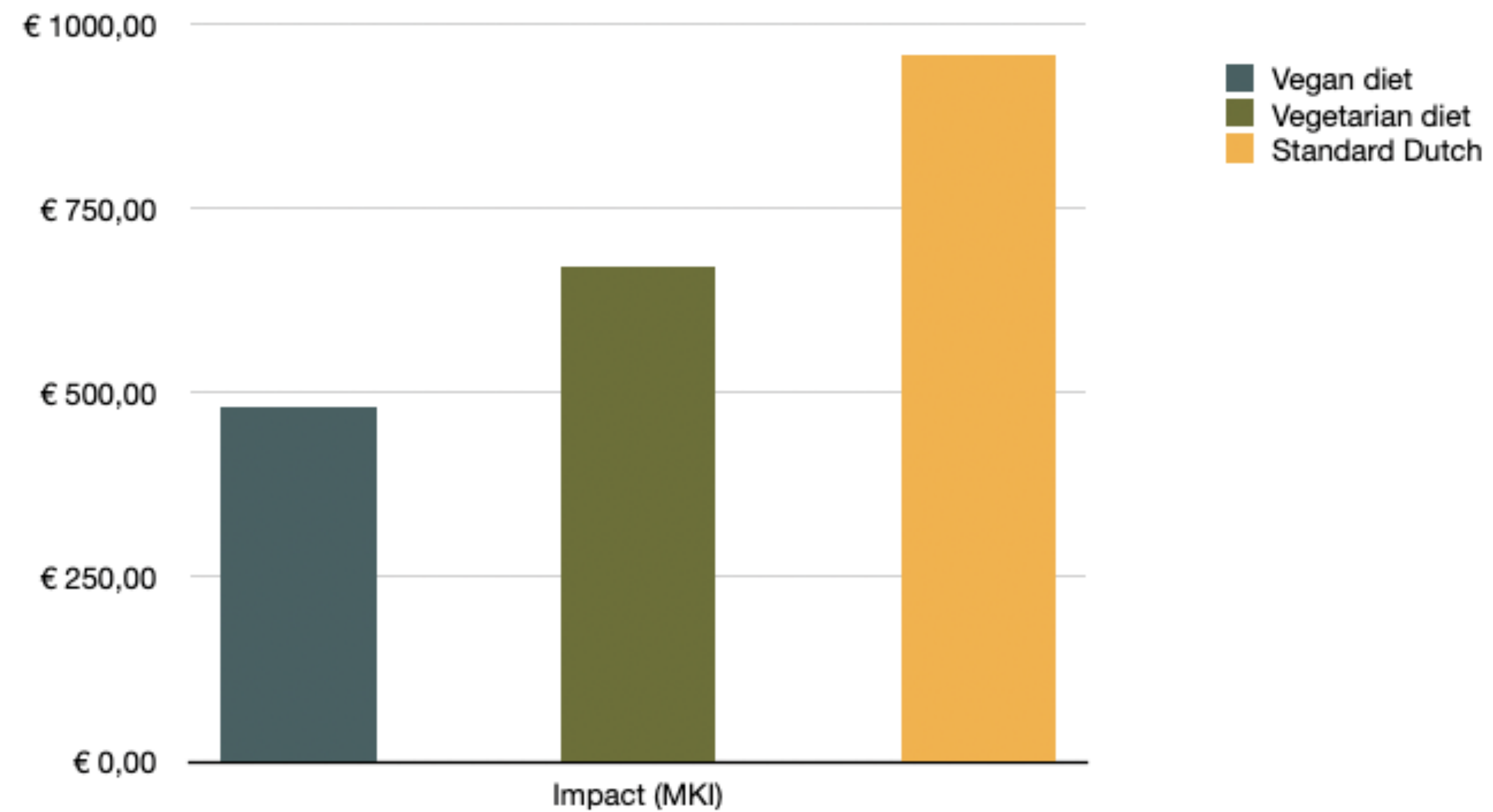
SEVEN

EXTRAS

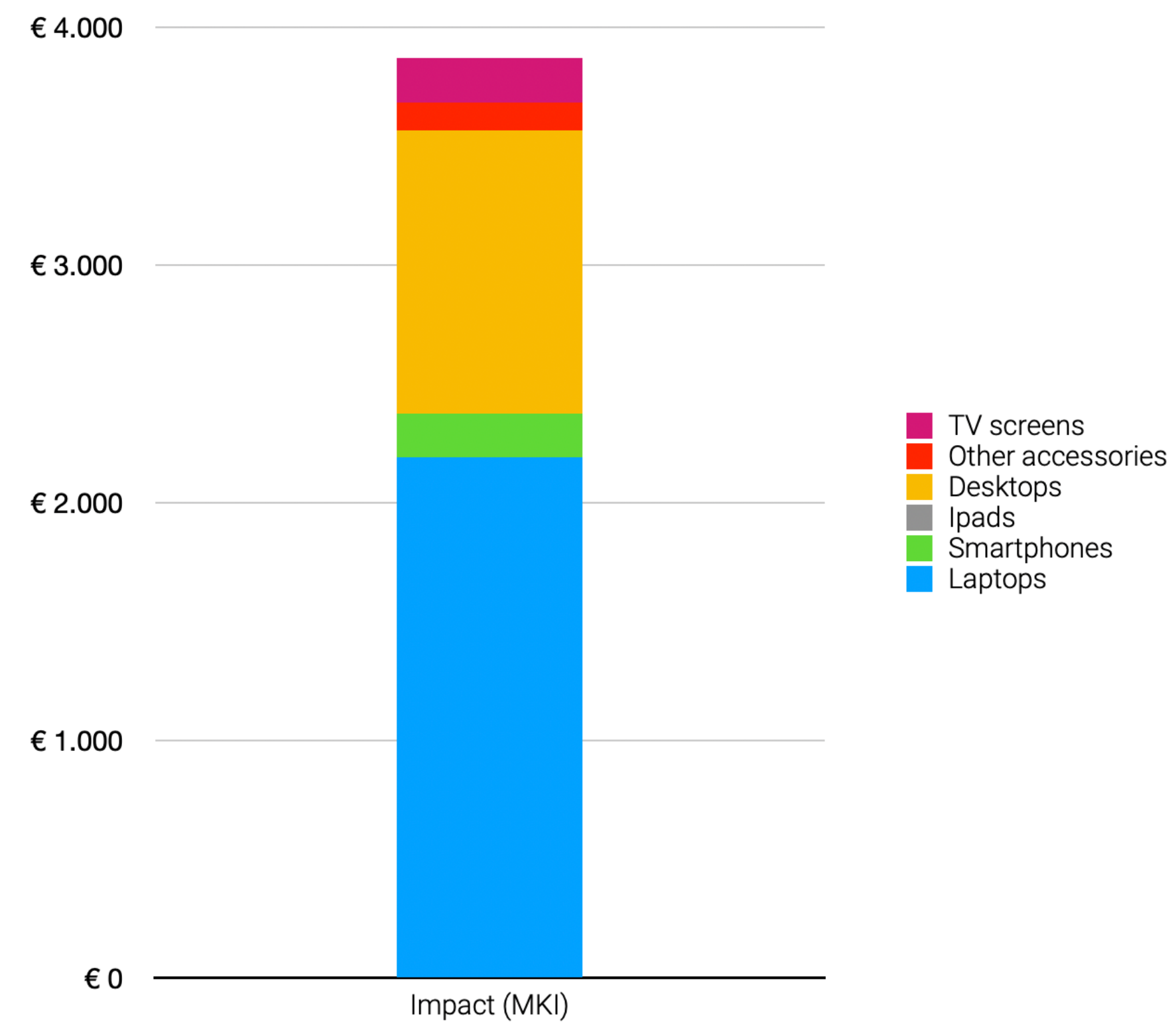
Extra's: office supplies



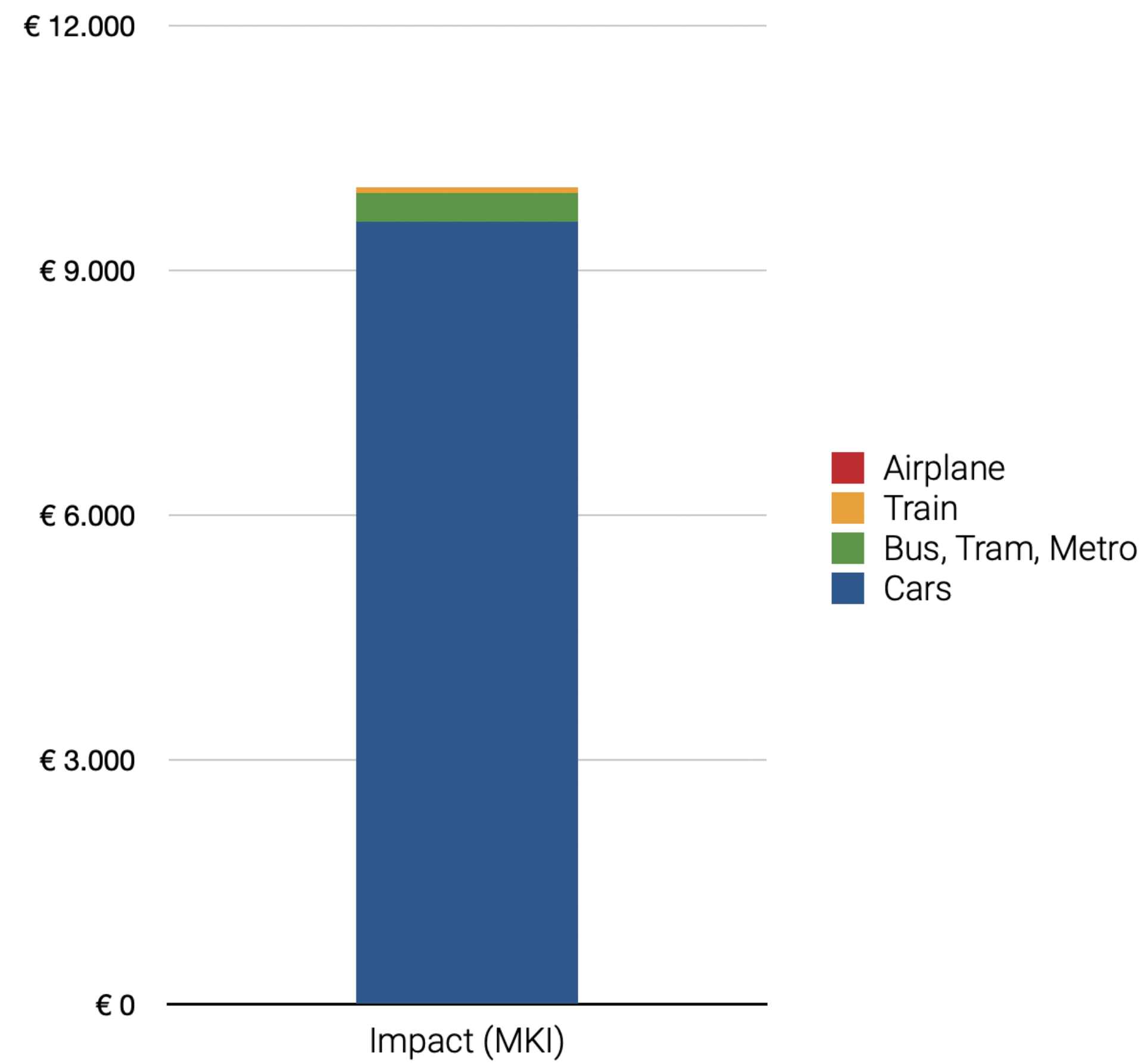
Extra's: lunch at the office



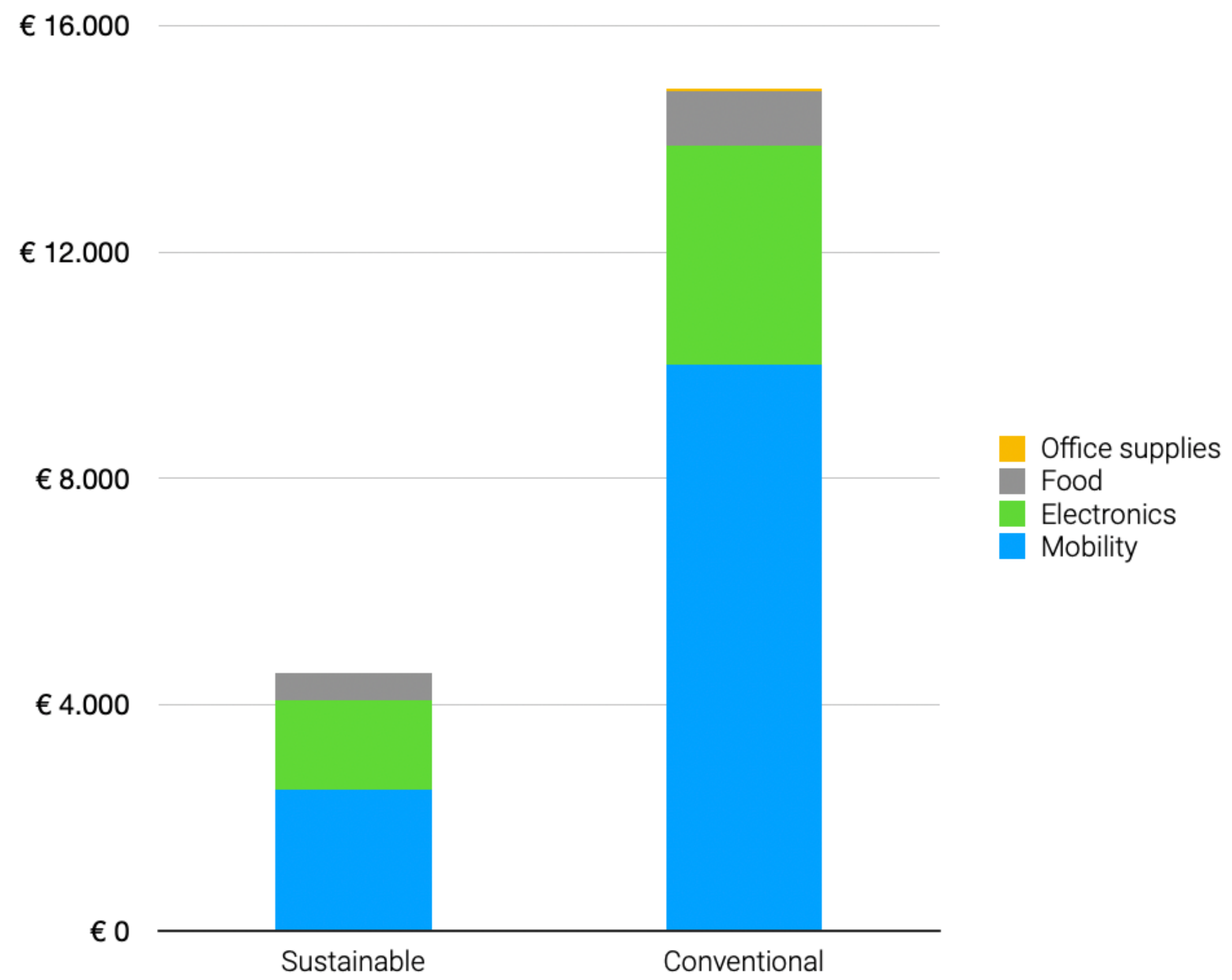
Extra's: office electronics



Extra's: home - work mobility



Extra's: Overall sustainable vs conventional overhead/office





Business benefits ecology

A transition towards a new economy is taking place. Challenges in the area of climate, resource availability and digitalization form our area of expertise. Not only because of a feeling of responsibility for generations to come, but also to utilize the business opportunities.

Together with our clients, we develop products and service that contribute to climate solutions. We combine the strength of business with the power of nature and develop solutions that empower your company or regio as well as society and ecology. This way we realize impact. Not only by talking but by applying scientific knowledge, experimenting and pioneering we implement the New Economy.



NEW ECONOMY

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Visit our website
<https://www.neweconomy.eco>



Where do we go from here?

The performed Quicksan shows **Fairm** its potential future impact for one production facility. Based on the impact analysis it was concluded that there are a few hotspots in terms of business activities. These hotspots show the most effective path to prevent negative impact namely reducing the energy usage of the climate control of the production facility (and other impacts).

Based on these new insights **Fairm** will be able to continu its work in strategic planning, priority setting, process or productdesign/ redesign in order to scale up the production. As a fast growing start up, the next steps will be challenging and exciting and new questions will continuously arise.

New Economy can offer support and strategic guidance to effectively scale up the innovations, find the best options for growth and contribute to a successful start of **Fairm's** first production facility.

About New Economy

New Economy develops products and services that contribute to the climate solution. We combine the power of business with the power of nature to arrive at solutions that strengthen **Fairm**. We achieve impact together with our clients by conducting research, experimenting, co-developing, pioneering and implementing the new economy.

Our team of specialists has in-depth knowledge of business development, energy transition, climate change, biodiversity, the biobased and circular economy. From current challenges towards future developments, including complex policy documents and biobased material applications New Economy works towards solid results.

New Economy offers its clients a unique range of products and services in relation to societal trends, needs and innovative business models.



How does this work?

New Economy works through an innovative model of collaboration. By organising strategic sessions once every two weeks New Economy delivers up-to-date and tailor-made external knowledge and insights about both strategic as well as more practical topics or challenges of your choice.

During a strategic session one topic will be highlighted that **Fairm** works on in the following period. Topics or challenges include working out a strategic energy plan, conducting stakeholder analysis, and attracting strategic partners. In addition to these strategic sessions, New Economy provides **Fairm** with business case calculations, concrete tools, (marketable) insights and/or product market validations.

New Economy provides **Fairm** with input during the entire phase in the form of monitoring relevant developments and news on the discussed themes and challenges. As continuously new questions arise, we will collaborate in prioritising needs and results. The outcome of this process is an effective workflow in innovation and offers **Fairm's** team the necessary tools to scale up production.

Identified topics & challenges

Strategy & planning

- Working out energy strategy, plan and attracting strategic partnerships
 - ▶ Stakeholder analysis and prioritising strategic partnerships
- Concept development & strategic market positioning
- Creating powerful tools for communications and marketing

Business case development & calculations

- Market validation
- Based on market validation: what investments would be required?
 - ▶ Return on Investment (ROI)

Strategic advice & assistance for desired building standards

- EPD (environmental product declaration) process / LCA impact measurements
- B-Corps certification

In depth research / Quicksan 2.0

- Continuing more in depth research towards (energy) innovation
- Coordinating & supporting (Master)student teams researching for Fairm (technical - energy - materials - marketing - production - business development etc.)



New Economy service packages

NE Strategy package

-  2 advisors
-  1 strategy session every 2 weeks
-  Continuous monitoring of news and relevant developments

€ 1500 per month

NE Strategy package +

-  2 advisors
-  1 strategy session every 2 weeks
-  Continuous monitoring of news and relevant developments
-  Developing tools, coordinating and supporting students
-  Working out projectplans etc. etc.

€ 2500 - €5000 per month

NE interim package

-  1 advisor + project team
-  **Strategy sessions can be included on request*
-  Continuous monitoring of news and relevant developments
-  Developing tools, coordinating and supporting students
-  Working out projectplans etc. etc.
-  Interim sustainability & business development manager

€ 6000 per month

**Combinations of the above are possible. Prices are a minimum and depend upon requested activities. Regular hour wage commercial projects is between €125,- - €175,- depending on technical expertise. Because we believe in Fairm's next generation building materials and are happy to support Fairm in a next phase. New Economy applies a reduced start-up wage. Minimum package duration of 3 month period required after this 1 month notice period for cancellations.*



Proposed project team



Iris Grobben, strategy advisor

As a consultant and connector, Iris is interested in making organisations more sustainable at a strategic level and guiding implementation processes. In this way she supports clients to translate the new economy into concrete steps that have a direct positive impact on the climate. Iris is a real connector and knows how to align interests with both business and government for maximum results. Where contradictions appear to arise, she becomes motivated to build bridges and ensures that a common goal is reached.

Partnerships & connector

Strategy

Food, agriculture & biobased economy



Jonah Link, data analyst

In his work Jonah translates abstract data into practically applicable models for analysis. From shadow cost calculations to cost-benefit analyses that provide insights into products, services, energy and material flows. With this he shows the relationship between the business model and the environmental impact. For example, he offers his client data-based advice to reduce the environmental impact and increase the added value for a company.

Data analytics

Impact KPI's

Construction & built environment



Pepijn Duijvestein, business inventor

Pepijn has been entrepreneurial in the new economy for years, with experience of guiding 30+ startups to market within both clean tech as well as med tech at Yes!Delft and New Economy. He has initiated many of his own projects and initiatives, such as Schip Aphrodite, and the building of his own energy-neutral houseboat, constantly questioning himself about trade-offs between both circular and biobased materials. Pepijn is proud that his energetic and pioneering attitude has been rewarded by award-winning projects in the new economy such as the Circular Award Public 2020 for the Circular Wood Chains project and Schoonschip.

Business & start-ups

Strategy

Industries