

# PART II CASE STUDIES

How to measure  
and maximise the climate  
impact of EU-funded  
start-ups

Rapid Acceleration  
of Climate Entrepreneurship  
(RACE) pilot project

An EIT Climate-KIC and European Innovation Council  
collaboration

European  
Innovation  
Council



Climate-KIC

Impact Shift

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European Union





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# Rapid Acceleration of Climate Entrepreneurship (RACE) pilot project – case studies

This document showcases nine start-ups supported by the RACE pilot project.


All start-ups in the RACE project had already been successful in joining the prestigious EIC Accelerator, which provides up to **€2.5 million of grant funding** (non-dilutive) and up to **€15 million in investments** (direct equity investments or quasi-equity such as convertible loans) to start-ups.

These EIC-supported start-ups were at a **higher level of maturity than the start-ups that EIT Climate-KIC usually supports in its accelerators.**


All nine of the start-ups showcased here achieved an **external validation of their climate impact forecast**. The selection is based on diversity and interest factor rather than quantity of emissions avoided.

Some of the more mature start-ups had already commissioned full lifecycle assessments. These start-ups used the Impact Shift forecasting tool or also called the Impact Shift emissions methodology for other purposes, which are described in the case studies.


## European Green Deal Priorities



Supplying clean, affordable and secure energy




Preserving and restoring ecosystems and biodiversity




Mobilising industry for a clean and circular economy



Farm to Fork: a fair, healthy and environmentally friendly food system




Building and renovating in an energy and resource-efficient way



Accelerating the shift to sustainable and smart mobility



A zero pollution ambition for a toxic-free environment



Pursuing green finance and investment and ensuring a just transition



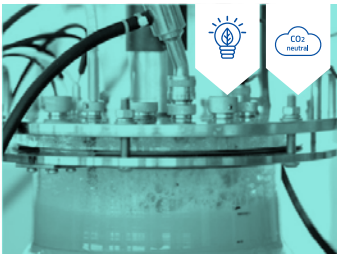
ALTAROAD



CIRCULARISE



CITIBOX SMART SERVICES, S.L.



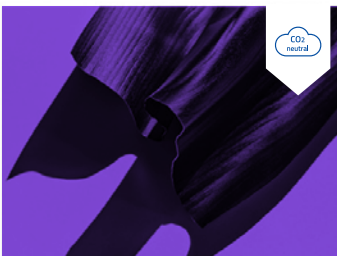
ELECTROCHAEA



ENERPOLY AB



QARNOT COMPUTING



SAS WOODOO



SOLIGHT LTD



TOMAPAIN



Mobilising industry for a clean and circular economy

Accelerating the shift to sustainable and smart mobility

# Case Study **Altaroad**

Altaroad is cutting CO<sub>2</sub>eq emissions from build site transportation

# Case Study Altaroad

Year of Establishment: 2017

Location: Paris, France

altaroad.com



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## Altaroad is cutting CO<sub>2</sub>eq emissions from build site transportation

- The start-up uses apps, cameras and weight-in-motion sensors to optimise cargo loads and construction waste traceability.
- In a year, 64 sites could offset the production of 24.000 m3 of concrete.

### What is Altaroad's climate innovation

Altaroad is tackling inefficiencies in the construction industry that lead to avoidable CO<sub>2</sub>eq emissions.

Their innovation captures and stores information about heavy goods trucks – and their contents – as they drive past cameras and weight-in-motion sensors without stopping.

The start-up aims to **eliminate two sources of emissions: underloaded heavy goods vehicles and ineffective tracing and waste management of building materials.**

Environmental quality managers can see the information immediately on dashboards via a secure digital interface and the information is stored for three years for auditing purposes. Drivers are also alerted in cases of overloading or underloading, which facilitates real time in-situ cargo optimisation.

The system cuts out paperwork and engine idling, but most importantly (for this case study), it **facilitates real-time decisions that reduce the number of truck journeys.**

### What are the problems and opportunities Altaroad addresses?

#### A shift to a circular construction sector

The building and construction sector's energy consumption and CO<sub>2</sub>eq emissions are at an all-time high, according to the 2022 Global Status Report for Buildings and Construction.

**A key recommendation of the report is that governments, especially cities, should implement policies that promote the shift to 'circular material economies'.**

This is an area that requires a lot of data capture, sharing and co-ordination. Altaroad seeks to enable this aspect of the circular economy by removing some of the problems associated with paperwork and manual processes in build site transportation and waste management.

#### Extended Producer Responsibility in the construction sector

During 2023 the building sector in France – where Altaroad is based – will be included in the country's Extended Producer Responsibility (EPR) legislation. This will give producers of building materials responsibility for the end-of-life environmental impacts of their products; building site managers will have related responsibilities.

Examples of EPR compliance activities could include: implementing take-back and recycling programmes for products; setting up collection points and recycling pickups for products; and designing new products that are easier to reuse, repair, and recycle.

Building sites will have to register information about materials used and offer proof of waste treatment and valorisation. The register must be synchronised with government tools and auditable for three years.

Altaroad is already working with a number of building and public construction sites in France in anticipation of this legislation coming into force in 2023.

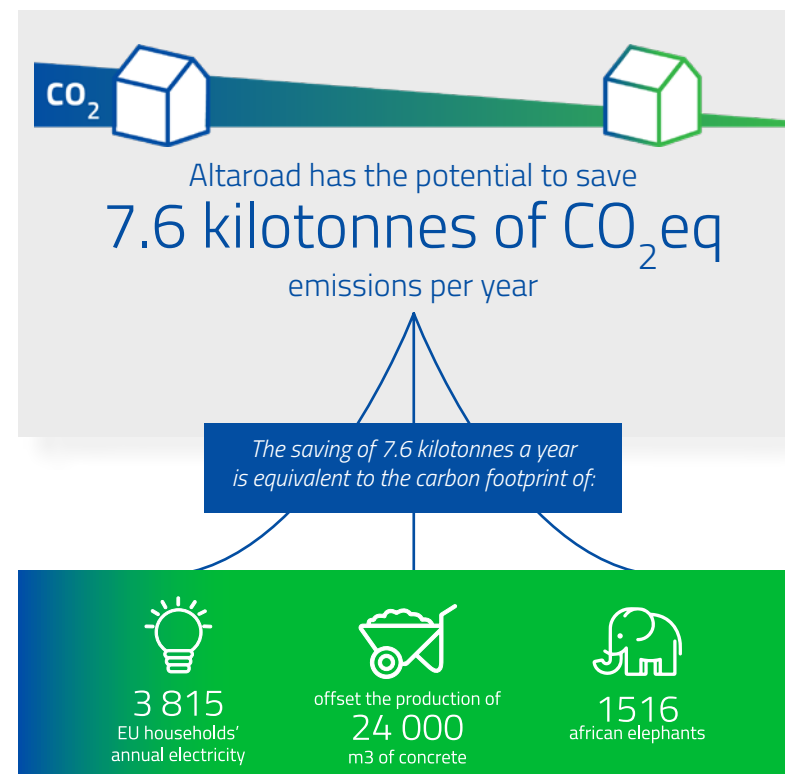
### What were the results of your Impact Shift calculations?

Baseline and boundaries of the forecast

This forecast calculated the benefit of transport efficiency on build sites offset against the production and use of a weight-in-motion sensor system and the energy consumption of Altaroad's office and data storage.

The calculation to determine the impact of Altaroad per year assumes that **100 construction sites are reached**, of which **80 per cent are expected to change on average 80 per cent of their current paperwork and unoptimised truck filling process.** This is equivalent to **64 fully changed users.**

## AVOIDED EMISSIONS



*"Our construction and municipality clients were immediately keen to use the Climate Impact Forecast tool. They had already asked us for this information. It helped that the availability of the tool coincided with new regulations on emissions reduction and waste management in the building sector in France. (...)*

*We are working in nine of the 100 departments in France. Our next step is to go international. The forecasts are very important for this. It is much more convincing to talk about impact, and easier to understand, than it is to talk only about compliance with the law."*



# Case Study Altaroad

Year of Establishment: 2017

Location: Paris, France

altaroad.com



## The results

### A saving of 7.6 kt CO<sub>2</sub>eq per year

Altaroad's innovation prevents 7.6 kt CO<sub>2</sub>eq from entering the atmosphere a year. Their positive climate impact is enough to offset the production of 24 000 m<sup>3</sup> of concrete or electricity consumption of 3815 EU households.

### EU Green Deal

Altaroad's contributions fall primarily under the EU target around 'Mobilising industry for a clean and circular economy' and 'Accelerating the shift to sustainable and smart mobility.' They are already working to integrate their system into government compliance frameworks in partnership with a number of local governments.

### How did you use the tool and how did it benefit your company?

Altaroad says:

"Our construction and municipality clients were immediately keen to use the Climate Impact Forecast tool. They had already asked us for this information. It helped that the availability of the tool coincided with new regulations on emissions reduction and waste management in the building sector in France.

Builders saw the opportunity to compete on impact rather than just on price and needed proof of this. Truck owners and drivers also said they want proof they are working better and cleaner.

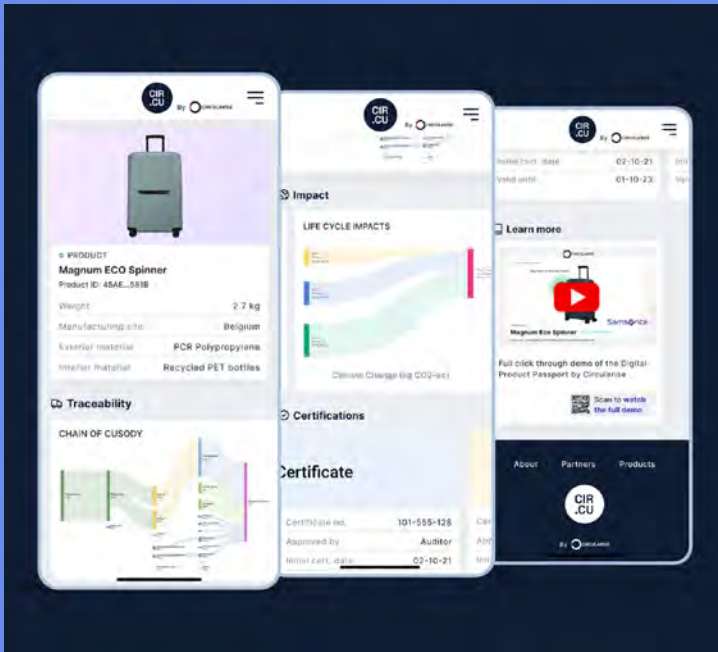
We are working in nine of the 100 departments in France. Our next step is to go international. The forecasts are very important for this. It is much more convincing to talk about impact, and easier to understand, than it is to talk only about compliance with the law."





Mobilising industry for a clean and circular economy

Pursuing green finance and investment and ensuring a just transition



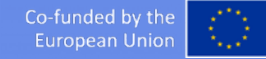
# Case Study **Circularise**

Circularise's digital product passports make a global circular economy possible



# Case Study Circularise

Year of Establishment: 2016 Location: The Hague, Netherlands and Tokyo, Japan circularise.com



## Circularise's digital 'product passports' make a global circular economy possible

- Circularise's patent pending Smart Questioning technology can verify statements on a public blockchain without revealing sensitive data.
- In the single use case tested for this pilot project (Nylon PA66), Circularise has the potential to save 551 kilotonnes of CO<sub>2</sub>eq emissions a year.

### What is Circularise's climate innovation

Circularise has built a Digital Product Passport (DPP) on a public blockchain (the Ethereum network). Their innovations in traceability support new legislation and objectives around sustainable production and circular economy.

The Circularise DPP gathers and shares data on the materials, components and processes required to produce a product as it flows through a supply chain. It maintains chain of custody and enables confidential information to be shared securely, replacing onerous spreadsheets, forms and email correspondence.

This information can be used to track materials and manufacturing practices and to verify compliance. It can facilitate improved design, product lifetime extension, recovery of useful materials, take-back operations and new service and repair-based business models. DPPs can also be used to influence green purchasing or even to reward customers for sustainable behaviours.

### What are the problems and opportunities Circularise addresses?

#### The Ethereum advantage – public, decentralised, immutable, trustless and transparent

Trust is a critical factor in our ability to shift whole systems. As an Ethereum application, the Circularise DPP has built-in features that make it both 'frictionless' for users and 'trustless' – that is, impossible to manipulate. Cryptographic strategies like zero-knowledge proofs and smart contracts increase trust and transparency in complicated supply chains without giving away confidential data.

Founders Jordi De Vos and Mesbah Sabur say it is because of these features, and their patent-pending Smart Questioning technology, that Circularise can overcome data and trust challenges in the areas of circular economy, environmental pollution and carbon emissions – without resorting to a central authority that holds proprietary information.

#### Lack of product and process information is a major barrier to building a circular economy

Recycling businesses today have very little information about the exact composition, renewable content or embedded carbon emissions in the products they are processing – so it is not surprising that so many products that 'go to recycling' end up in landfill.

Less than one per cent of rare earth materials are recycled at end of life today, yet supply is struggling to keep up with demand, including demand, for example, from battery makers and wind turbine manufacturers.

#### Only nine per cent of all plastic ever made has been recycled into new plastics.

*"A global circular economy that actually takes pressure off scarce natural resources, reduces CO<sub>2</sub>eq emissions and saves costs requires deliberate design. Product passports mean we have the right information to reintroduce assets and materials back into the economy as often as possible."*

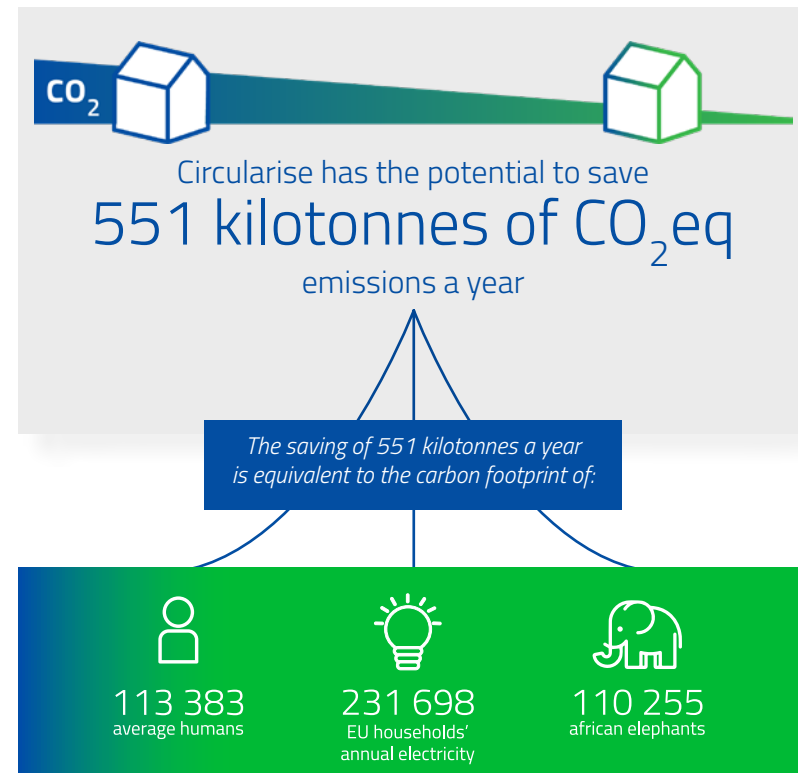
Circularise recently worked with Philips on their Eco Conscious Collection. The company markets their collection by quantifying the nature-based content of the products.

### What were the results of your Impact Shift calculations?

#### Baseline and boundaries of the forecast

Circularise is particularly active in plastics supply chains, so the baseline of this climate impact forecast is based on a single use case: 200,000 tonnes of minimally tracked nylon (polymite 66).

## AVOIDED EMISSIONS



*"More and more customers and clients are asking for proof of climate impact. With this tool we are able to help validate products across complex supply chains. We also used it to shorten the learning curve when testing multiple scenarios in product development – including selection of suppliers and materials. It's really important to see where the hotspots of impact are, and where the opportunities for trade-off exist within a complex supply chain. The tool also helps you gain insights into a more complex Life Cycle Assessments."*

- Sabur



# Case Study Circularise

Year of Establishment: 2016 Location: The Hague, Netherlands and Tokyo, Japan

## This is compared with a scenario where 200,000 tonnes of nylon are tracked by Circularise.

In this scenario recyclers are provided with previously unavailable information on the composition, Mass Balanced material flows and LCA details of materials flowing through a nylon supply chain.

This data supports more recycling in the nylon chain. The waste management and recovery processes the data enables also ultimately reduce the need for primary production.

## Each blockchain transaction uses electricity and hardware and this is included in the calculations.

This impact forecasting process can be expanded to other material and product streams to get closer to the actual impact of the company's technology.

## The results

Circularise has the potential to enable the saving of around 551 kilotonnes of CO<sub>2</sub>e emissions every year for every plastic supply chain they change through their innovative solution (or for a ten per cent improvement in ten supply chains). Even if this amount decreased by 95 per cent, the impact of Circularise would still be significant according to the five tonne threshold of the tool.

The saving of 551 kilotonnes a year is equivalent to the carbon footprint of:

- 113 383 average humans
- 231 698 EU households' annual electricity
- 110 255 elephants' mass.

## EU Green Deal

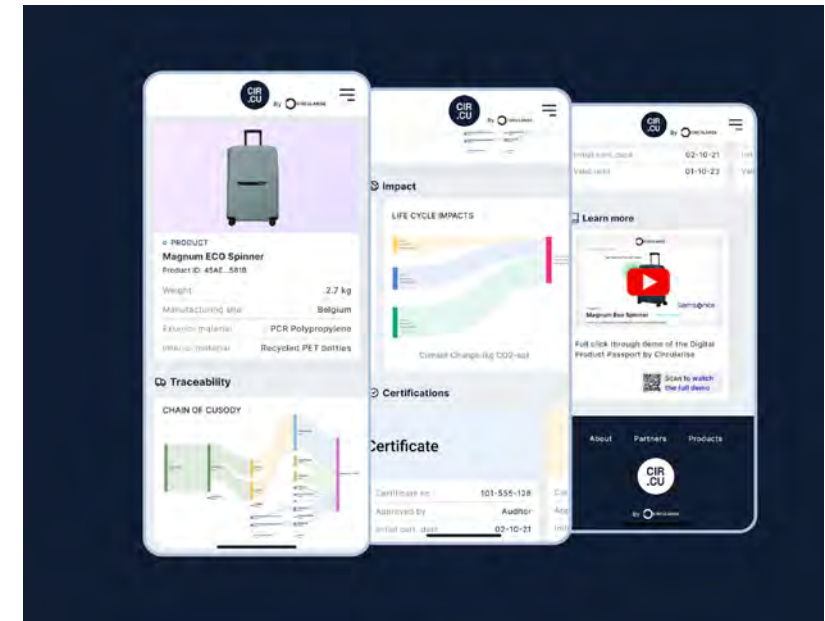
Circularise's contributions fall primarily under the EU target around 'Mobilizing industry for a clean and circular economy' however nearly every EGD target would be served by DPPs.

Battery passports have set a precedent for DPPs, but with other related regulations coming into effect like the proposed Ecodesign for Sustainable Products Regulation, other DPP requirements will be rolling out. These will be based on targeted product categories that align with the EU Circular Economy Action Plan.

## How did you use the tool and what were the benefits?

Sabur says:

"More and more customers and clients are asking for proof of climate impact. With this tool we are able to help validate products across complex supply chains. We also used it to shorten the learning curve when testing multiple scenarios in product development – including selection of suppliers and materials. It's really important to see where the hotspots of impact are, and where the opportunities for trade-off exist within a complex supply chain. The tool also helps you gain insights into a more complex Life Cycle Assessments."





Accelerating  
the Shift to  
Sustainable  
and Smart  
Mobility



# Case Study **Citibox**

Citibox is cutting CO<sub>2</sub>eq emissions from failed parcel delivery



## Citibox Citibox is cutting CO<sub>2</sub>eq emissions from failed parcel delivery

- Shared 'smart lockers' in building lobbies can increase courier productivity and eliminate second and third delivery journeys.
- The start-up plans to convert 3 million people in Madrid and Barcelona to Citibox, to save 35 kilotonnes of CO<sub>2</sub>eq over 10 years.

### What is Citibox's climate innovation?

If we're not home to receive a parcel, many courier companies will take the parcel back to the warehouse and attempt a second or third delivery on consecutive days.

Citibox wants to ensure first-time, secure delivery for any courier.

Their two-part innovation combines parcel lockers (in a range of sizes, installed in the lobbies of residential buildings) with an app. The app connects retailer, courier and recipient and allows the recipient to open a locker with a unique digital key. The service can be used by all couriers and retailers.

### What are the problems and opportunities Citibox addresses?

Different cities present different opportunities to reduce CO<sub>2</sub>eq emissions, congestion and pollution. Citibox is already operating in Madrid and Barcelona and the team has researched opportunities to expand into many other European cities.

In any city, guaranteeing secure parcel delivery on the first attempt will save emissions associated with second and third delivery attempts.

Courier companies can also maximise deliveries per stop, as they are delivering all parcels to secure boxes in a lobby rather than to each front door.

An additional benefit is that locked boxes ensure safe delivery when we're not at home or 'after hours'. Some city centres restrict truck access during daytime hours; Citibox enables secure night-time delivery.

These emissions savings opportunities can also reduce the number of vehicles on the road and reduce idling on the road, leading to less congestion,

less noise pollution and less pollution linked to brakes, tires and road dust.

### What were the results of your Impact Shift calculations?

#### Baseline and boundaries

The reduction of second and third delivery journeys must be offset against the embodied carbon of the lockers and app, and then compared with the impacts of 'business as usual'.

In both Madrid and Barcelona, at least 8 per cent and up to 17 per cent of parcels cannot be delivered at the first attempt. Another one per cent fail at the second attempt. This Citibox case study assumes a failed delivery rate of 8 per cent per user, i.e. over a ten-year period 31 parcels are re-delivered. These assumptions, as well as distances travelled and number of parcels delivered were based on actual carrier data.

Overall, Citibox is expected to reach up to 3 million users in Madrid and Barcelona by 2025.

### The results

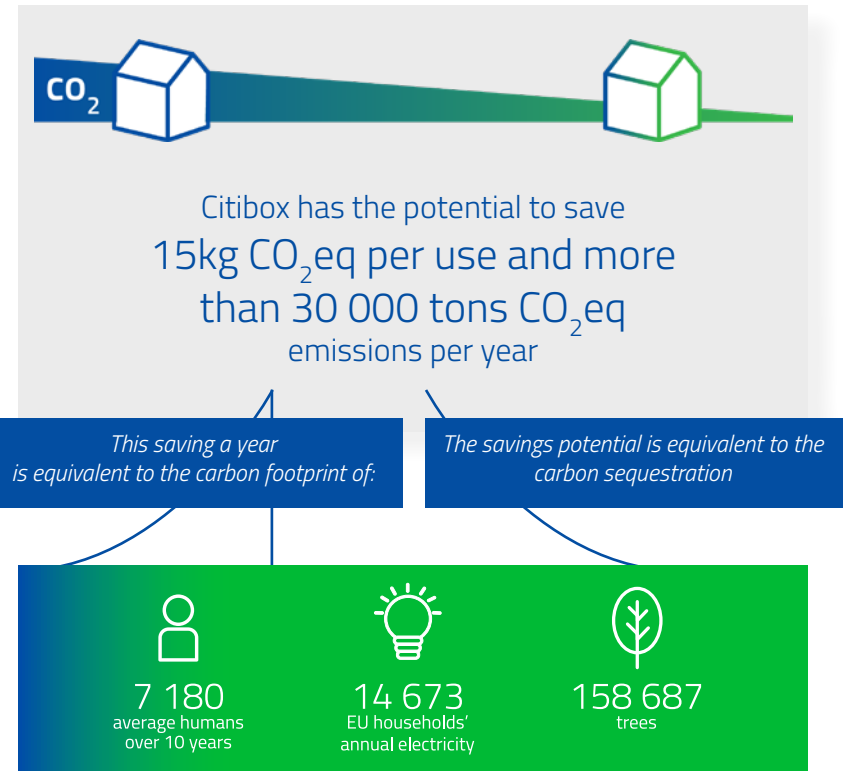
Over ten years, Citibox has the potential to prevent carbon emissions of 15 kg CO<sub>2</sub>eq per user and more than 30 000 tons CO<sub>2</sub>eq for all users reached in the case study scenario.

This saving is equivalent to sequestering CO<sub>2</sub>eq emissions from:

- **7 180** 'average' humans over 10 years or
- electricity consumption of **14 673** EU households over a year.

The savings potential is equivalent to the carbon sequestration of 158 687 trees.

## AVOIDED EMISSIONS



*"Contributing to creating sustainable cities is part of Citibox's vision. This tool helped us to calculate the actual impact Citibox is having already as well as the impact we can have in the future. This is very useful data to share with investors and customers."*

- Citibox



# Case Study Citibox

Year of Establishment: 2015

Location: Madrid, Spain

[citibox.com](http://citibox.com)

European  
Innovation  
Council



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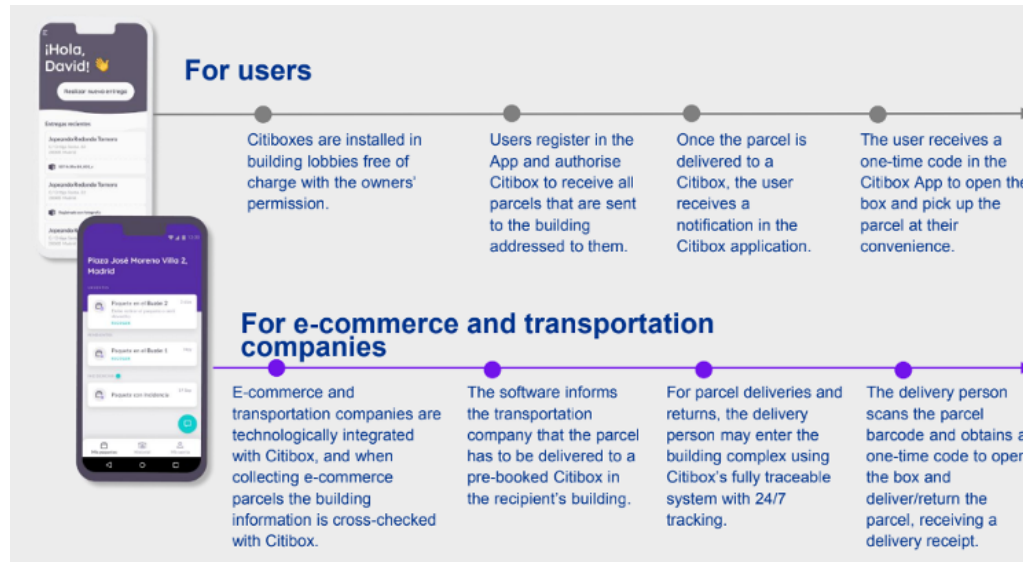


## EU Green Deal

Citibox will have an impact on two of the areas covered by the European Green Deal: "a zero-pollution ambition for a toxic-free environment" and "accelerating the shift to sustainable and smart mobility".

## How did you use the climate impact forecasting tool, who was most interested in the data and what were the benefits to your business?

Contributing to creating sustainable cities is part of Citibox's vision. This tool helped us to calculate the actual impact Citibox is having already as well as the impact we can have in the future. This is very useful data to share with investors and customers.





Supplying clean, affordable and secure energy

A zero pollution ambition for a toxic-free environment

# Case Study **Electrochaea**

Electrochaea produces fossil-free methane as storage for renewable energy systems

# Case Study Electrochaea

Year of Establishment: 2014

Location: Munich, Germany

electrochaea.com

European  
Innovation  
Council



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European Union



## Electrochaea produces fossil-free methane as storage for renewable energy systems

- Electrochaea's proprietary bio-methanation process offers a 78 per cent decrease in the carbon intensity of gas used for heat.
- The start-up is harnessing a 3-billion-year-old bio-process to produce fossil-free methane

### What is Electrochaea's climate innovation?

Electrochaea produces grid-quality 'e-methane' that can be injected straight into the existing gas grid or used as a clean fuel.

Their competitive edge is a patented biocatalyst and a proprietary **process that uses a selectively evolved micro-organism called an archaea to convert hydrogen and CO2 into 'e-methane', water and heat.**

The bio-methanation process the start-up has learnt to harness has been performed by this micro-organism for around 3 billion years.

These hard-working micro-organisms significantly increase the volumetric productivity of biomethanation plants so that smaller plants and lower investment cost are required to generate clean gas.

Electrochaea's innovation is a two-step process:

- First, water is split into hydrogen and oxygen using an electrolyser powered by unwanted, under-priced or difficult-to-store renewable solar or wind power.
- Then the hydrogen is combined with carbon dioxide in the bio-methanation reactor where the archaea digest the gases to produce e-methane.

The CO2 feedstock can come from any source – anaerobic digestors, landfills, dairies, fermentation facilities or industrial processes. Even direct air capture could be an option.

Together, these processes plus injection into the gas grid amount to a method of storing and redistributing renewable energy to where it is needed when it is needed.

From a storage perspective Electrochaea sees their technology as the charging element. The battery piece is the existing gas grid, which has no capacity constraints unlike electricity grids.

The company's pilot plants have successfully injected their renewable methane into commercial gas grids in Switzerland and Denmark, and it is a proposed plant in Denmark that was chosen as the target project for this Climate Impact Forecast case study.

### What are the problems and opportunities Electrochaea addresses?

Electrochaea's goal is to decarbonise the gas grid at scale to allow more renewable energy into the global energy system.

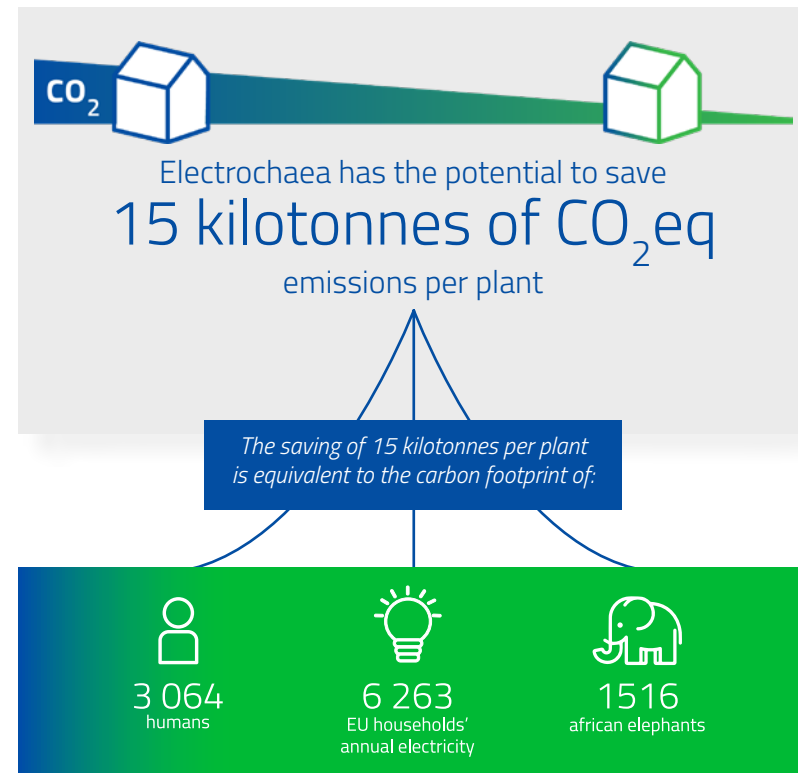
"Our innovation holds particular promise for hard-to-abate sectors such as steel or lime industry," says Electrochaea's CTO and Managing Director, Dr. Doris Hafenbradl, "because it can drastically reduce greenhouse gas emissions and address the release of CO<sub>2</sub> by separating and recycling the CO<sub>2</sub> as an input to the production e-methane."

More broadly, the ideal energy mix for getting the world to net zero in time to avoid climate catastrophe is the subject of urgent research and debate.

Gas will continue to provide crucial back-up for renewable energy systems until batteries or other forms of storage become cheaper and more accessible.

The company also has an additional source of positive impact: **they transport the heat generated by their production process (by the electrolyser and the bioreactor) to a nearby farm where they replace industrial heat used for the industrial-related processes of the farm (e.g. the anaerobic digestion of farm waste).**

## AVOIDED EMISSIONS



*"As a growth-stage company we had already done full LCAs. The external validation of our impact results provided by the EIT Climate-KIC framework was very important for us – and important for our marketing and outreach conversations.*

*A small drawback was that the database is quite Europe focused and data available did not cover the US, so we had to look for substitutes quite often."*

- Dr. Doris Hafenbradl



# Case Study Electrochaea

Year of Establishment: 2014

Location: Munich, Germany

electrochaea.com

European  
Innovation  
Council



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## What were the results of your Impact Shift calculations?

### Baseline

Electrochaea calculated the climate impact potential of their innovation when compared with the 'business-as-usual' baseline of carbon-intensive fossil methane.

The specific scenario they modelled was a proposed **10MW bio-methanation plant in Denmark producing 2793 tonnes of e-methane a year.**

This scenario is scaled up from the company's actual 1MW pilot plant projects in Switzerland and Denmark, which proved the technology.

Electricity is needed to produce the hydrogen feedstock, so a yearly wind profile was used to calculate that 1200h/year out of a total of 8000h/year of electricity would need to come from the Danish electricity grid rather than from direct wind energy.

**In this scenario waste heat produced by the electrolyser and the bio-methanation reactor was exported to a nearby farm for anaerobic waste management, contributing additional CO<sub>2</sub>eq savings.**

### The results

**A 78% decrease in the carbon intensity of gas used for heat and of industrial heat**

At this scale, Electrochaea has the potential to save 344 kg of carbon (CO<sub>2</sub>eq) emissions for every MWh of methane they produce. This would amount to a yearly total carbon emission saving of 15 kilotonnes of CO<sub>2</sub>eq per plant.

That's equivalent to the annual electricity needs of:

- **6 263** EU households or
- the CO<sub>2</sub>eq footprint of **3 064** humans

### Potential impact

The technology is proven and available today, but it is still more expensive than its fossil gas alternative.

Dr. Hafenbradl says that a lot will depend on the future value of carbon removal, as well as on classification and regulation.

"Governments are still working on classifying and regulating the use of clean gases in the grid," says Hafenbradl.

**Right now, she calculates that two hundred plants of 100 MW each could cover all of Germany's gas needs.**

### EU Green Deal

Electrochaea's contributions fall under EU targets around 'Mobilising industry for a clean and circular economy'; 'A zero-pollution ambition for a toxic-free environment' and 'Supplying clean, affordable and secure energy'.

### How did you use the tool and what were the benefits?

Dr. Doris Hafenbradl says:

"As a growth-stage company we had already done full LCAs. The external validation of our impact results provided by the EIT Climate-KIC framework was very important for us – and important for our marketing and outreach conversations.

A small drawback was that the database is quite Europe focused and data available did not cover the US, so we had to look for substitutes quite often."



Enerpoly



Supplying clean, affordable and secure energy



Mobilising industry for a clean and circular economy

# Case Study **Enerpoly**

Enerpoly's zinc-ion battery resolves safety, cost and raw- material-supply challenges

# Case Study Enerpoly

Year of Establishment: 2018

Location: Stockholm, Sweden

enerpoly.com



Impact Shift



## Enerpoly's zinc-ion battery resolves safety, cost and raw-material-supply challenges

- The start-up aims to make energy storage accessible for all EU households.
- EU grant funding will help them demonstrate a plug-in energy storage system using European materials and manufacturing.

### What is Enerpoly's climate innovation?

Enerpoly has developed a proprietary zinc-ion battery technology that can be used to either complement or replace lithium-ion batteries in many stationary energy storage applications.

The Swedish start-up is currently developing and producing **battery cells and packs that can be used for two-ten-hour discharge durations**. This includes on-grid and off-grid storage residential and commercial building use. Enerpoly plans to expand into industrial and grid-scale settings in the future.

Enerpoly's batteries use cost-effective non-critical materials, including zinc, that are globally abundant, including in Europe. Zinc deposits, for example, are available in Sweden.

In 2023, they are launching ZincMate, a partnership project with Austrian smart photovoltaic start-up, EET - Efficient Energy Technology. **ZincMate will demonstrate a plug-in energy storage system that can be used by any EU household including apartments, small living spaces, and shared housing.**

The technical basis for ZincMate is Enerpoly's cost-effective rechargeable zinc-ion battery in combination with EET's photovoltaic technology.

The project aligns with EU's goals of energy savings and accelerating the roll-out of renewable energy to replace fossil fuels in homes and in power generation. The EU grant funding of €870K contributes to the total project budget of €1.74 million.

### What are the problems and opportunities Enerpoly addresses?

Enerpoly markets their battery as a safer, more reliable and "incredibly cost-efficient" solution for stationary energy storage, when compared with today's battery technologies.

The abundant and non-flammable, non-explosive and non-toxic raw materials used leads to the battery's affordability and safety. The electrolyte and manufacturing process is water-based, which also contributes to the reduced need for precautionary safety infrastructure and dry rooms in both battery manufacturing and product development.

Europe is lagging China and USA in securing raw material supply for energy and mobility systems. Switching to zinc-ion technologies can contribute to the region's global competitiveness within the fast-growing battery industry.

These charts provide some context to the price differences in raw materials/global production, the price volatility of materials used, and the forthcoming supply/demand imbalances.

### What were the results of your Impact Shift calculations?

#### Baseline and boundaries

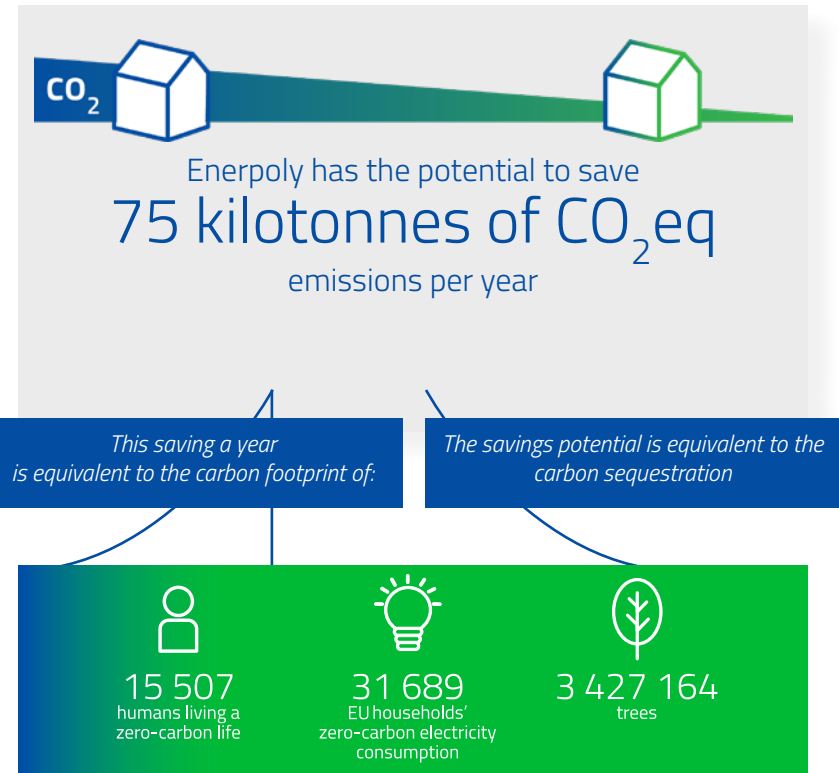
The 'business-as-usual' baseline for this climate impact case study is lithium-ion batteries. The difference in impact is calculated per year. **The total impact of Enerpoly per year is calculated for 100,000 units of a 10kWh battery with a ten-year lifetime, this being the company's 2027 sales target.**

The climate impact forecast focuses on the production phase, where the greatest differences in impact are observed. The components of the zinc-ion battery required to produce a 10kWh unit with a ten-year lifetime are considered, including the particular electricity mix which is geared towards renewables in Sweden.

#### The results

At the scale of production modelled in this climate impact forecast, Enerpoly achieves a reduction in climate impact of 75 kt CO<sub>2</sub>eq per year.

## AVOIDED EMISSIONS



*"We knew that our product was sustainable however we did not have a tool that measured the impact. The climate impact forecasting tool solved this problem for us and provided an evidence-based approach to make strategic business decisions. It helped us plan for our production scaling up activities. This in turn has helped Enerpoly in communicating with different stakeholders such as investors, customers, and partners."*

- Samer Nameer, Chief Sustainability Officer and Co-founder



# Case Study Enerpoly

Year of Establishment: 2018

Location: Stockholm, Sweden

enerpoly.com



This is equivalent to the combined carbon sequestration of more than 3 427 164 trees.

Similar CO<sub>2</sub>e savings could be achieved by:

- 31 689 EU households achieving zero-carbon electricity consumption or
- 15 507 humans living a zero-carbon life.

Even if lithium-ion batteries were to become much more efficient and if the material input required were reduced by 76 per cent, Enerpoly's zinc-ion battery would still have a significant positive impact based on the study's threshold for significance, which is greater than five tonnes of CO<sub>2</sub>e per year, roughly the global average annual CO<sub>2</sub> emissions per person.

## EU Green Deal

Enerpoly's innovation makes a significant contribution to the EU Green Deal policy area of "supplying clean, affordable and secure energy".

The start-up is gathering evidence in support of their ability to enable 100 per cent renewable energy on a global scale.

Their product had already proven itself a more desirable alternative to lithium-ion batteries in Europe, on the basis of cost, safety and supply chain reliability. This case study now points to a robust and significant climate impact potential as well, on the basis of CO<sub>2</sub>e savings in the production phase.

## What were the results of the Impact Shift forecast? How did you use the tool, who was most interested in the data and what were the benefits to your business?

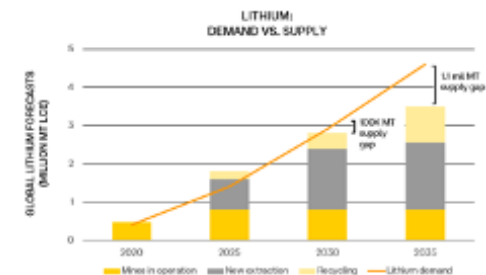
"We knew that our product was sustainable however we did not have a tool that measured the impact. The climate impact forecasting tool solved this problem for us and provided an evidence-based approach to make strategic business decisions. It helped us plan for our production scaling up activities. This in turn has helped Enerpoly in communicating with different stakeholders such as investors, customers, and partners." – Samer Nameer, Chief

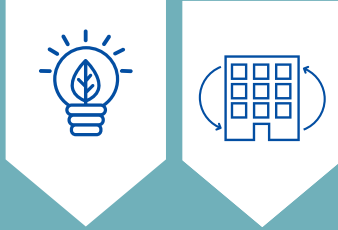
Sustainability Officer and Co-founder"



## NEED FOR ABUNDANT, AVAILABLE MATERIALS

Lithium supply shortage expected by 2030





Supplying clean, affordable and secure energy

Building and renovating in an energy and resource-efficient way

# Case Study **Quarnot**

## Cloud computing that reuses heat

# Case Study Quarnot

Year of Establishment: 2010

Location: Montrouge, France

quarnot.com



Impact Shift



## Cloud computing that reuses heat

- Qarnot avoids CO<sub>2</sub>eq emissions by replacing gas boilers with IT waste heat.
- They use on average 81 per cent less carbon than the average datacentre in Europe.

## What is Qarnot's climate innovation?

Qarnot has developed a computing module that is also a boiler, using IT processors as a heat source.

The Qarnot Boiler, or QB, houses 12 to 14 processors along with pipes and heat exchangers that transfer IT waste heat to a building's heating system – or to a heat network, industrial site or swimming pool.

The QB not only eliminates the need for a gas boiler and IT cooling in the buildings that host them, but the decentralised model also eliminates the need for the construction of new datacentres.

## What are the problems and opportunities Qarnot addresses?

High-performance cloud computing generates a lot of heat. Computer rendering for an animation feature film like Toy Story could heat an average French home for 715 years. Or the city of Paris for seven days.

Without the know-how (or willingness) to re-use this heat, most large datacentres fight it instead. Cooling high-performance computers drives costs, water usage and CO<sub>2</sub>eq emissions up.

**Meanwhile, heating our buildings and industries accounts for 40 per cent of Europe's CO<sub>2</sub>eq emissions, and the rising cost of heat is at the heart of today's cost-of-living crisis.**

With the QB, Qarnot has created a whole new infrastructure for cloud computing that 'multi-solves' for the costs and CO<sub>2</sub>eq emissions associated with:

- cooling high-performance IT hardware
- heating buildings, and
- construction and maintenance of new datacentres.

Qarnot sells both heat and IT services, but not necessarily to the same clients. Overall, costs are lowered for everyone – heating clients and computing clients.

Today Qarnot has more than 50,000 computing cores spread over many sites in France and Europe.

## What were the results of your Impact Shift calculations?

### Baseline

Qarnot is changing the system in which they operate; their two-sided business model sells both cloud computing services and renewable energy.

There is no direct comparison with anything that currently exists.

Therefore, the 'business-as-usual' comparison for their Qarnot Boiler was server in a centralised cloud computing system plus a natural gas boiler in an average home.

Their calculations used the global footprint of manufacturing, use and end of life. (Datacentres usually replace processors every three years; Qarnot extends use up to 7 or 8 years).

### The results:

The Qarnot Boiler won out over today's 'business-as-usual' approach to cloud computing. The total impact of 1000 Qarnot Boilers would be a saving of 5.6 kt CO<sub>2</sub>eq.

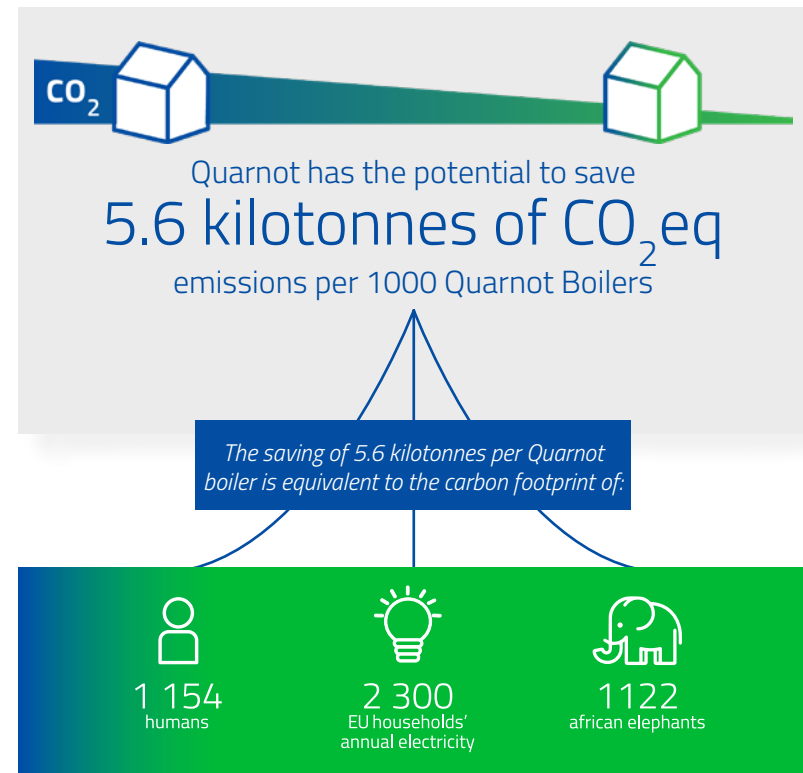
This saving is equivalent to:

- the annual electricity use of more than **2 300** EU households or
- the climate impact of **1 154** humans.

The savings break down as follows:

- The saved electricity, otherwise used to cool computers, brings a reduction of two tonnes of CO<sub>2</sub>eq per QB per year.
- The avoided use of natural gas brings a reduction of five tonnes of CO<sub>2</sub>eq per QB per year.

## AVOIDED EMISSIONS



*"We have developed technologies that deliver what datacentres do in a much more efficient way that also addresses heat decarbonisation challenges. Our emitted energy can heat swimming pools, heat networks, buildings and industrial processes. Our business model is evolving as we explore these synergies with city councils, big corporates and national governments."*

- Benoit



# Case Study Quarnot

Year of Establishment: 2010

Location: Montrouge, France

quarnot.com



- A QB system uses a bit more energy than a centralised system uses for the same amount of calculation, so an additional 1.6 tonnes of CO<sub>2</sub>eq per QB per year are emitted as a result.

Additional benefits to climate impact come from avoiding the land use change and concrete building needed for a datacentre, reduction of coolant leakage, and from avoiding the use of fossil-fuelled generators.

In terms of CO<sub>2</sub>eq reductions however, by far the biggest impact is from avoided use of natural gas.

Qarnot co-founder Paul Benoit describes Qarnot today as “the most efficient IT infrastructure leveraging heat re-use today.”

Compared with common datacentres in Europe, he says, Qarnot’s computing services use on average 81 per cent less carbon and 65 per cent less energy. No water is wasted to cool down processors, and they convert 96 per cent of incoming electrical power into thermal energy.

## EU Green Deal and the evolution of Qarnot’s business model

On the IT side, Qarnot has worked mostly with companies in sectors that require the most energy-intensive and high-performance computing, such as risk analysis for big banks and 3D animation studios.

On the heating side, previous customers have included housing projects in France and Finland. “The scope for regenerative business and public-private partnerships is enormous,” says Benoit.

Looking ahead, the year 2023 will see a pivot towards supplying heat networks and industrial processes to support emissions reductions in areas supported by the EU Green Deal such as the Green Deal’s Fit for 55 especially the energy efficiency directive, as well as articles 66 and 67 related to datacentres.

Benoit says:

“We have developed technologies that deliver what datacentres do in a much more efficient way that also addresses heat decarbonisation challenges.

Our emitted energy can heat swimming pools, heat networks, buildings and industrial processes. Our business model is evolving as we explore these synergies with city councils, big corporates and national governments”

The company’s January 2023 funding round raised €35M to scale up the company and install larger sites.





Supplying clean, affordable and secure energy

Building and renovating in an energy and resource-efficient way



# Case Study **Solight**

A healthier, lower-carbon alternative to LED for day-time lighting

# Case Study Solight

Year of Establishment: 2012

Location: Israel

[solight-energy.com](http://solight-energy.com)



Impact Shift

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## A healthier, lower-carbon alternative to LED for day-time lighting

- Solight channels natural light to dark spaces to reduce emissions from artificial day-time lighting.
- The start-up also tracks benefits to human health from substituting LED bulbs with natural lighting.

### What is Solight's climate innovation?

Solight Ltd. manufactures a lighting system that uses static, multi-mirrored periscopes to channel sunlight through metal tubes into dark spaces in buildings, including basements, overshadowed rooms and homes, and windowless factory and hospital spaces.

**This technology replaces daytime use of LED bulbs. Over 20 years, a single SOLIS Max product would replace 348 LED bulbs assuming a bulb with a five-year lifespan.**

SOLIS mirrors can allow solar heat into a room or filter it out, thus also offering cooling or space heating benefits.

Solight currently has three products on the market. They are participating in pilot projects to quantify benefits in various applications, including industrial settings, homes, schools, hotels and hospitals.

The company was founded by brothers Ofer and Dror Becker in Israel in 2012. Their initial focus was on the wellbeing benefits of natural lighting during daylight hours.

### What is the problem Solight addresses?

Solight is 'multi-solving' for a range of problems associated with the spread of LED lighting:

- The specific problem addressed by the forecast tool was the **climate impact of electricity use for LED lighting during daylight hours**. LED is significantly more energy-efficient and costs much less to run than incandescent or halogen lighting. "But there are human and ecological costs associated with this technology," says Ofer. To gain attention and support for the wellbeing

benefits of their innovation from EU funders, they first needed to compare the climate change impacts of their innovation with the climate change impacts of LED, the relevant 'business-as-usual' technology.

Solight's innovation also addresses negative health and biological impacts associated with LED lighting with high levels of blue light. Multiple academic and scientific studies have provided evidence of the impacts of LED lighting and/or absence of 'daylighting' on human health and wellbeing, including suppression of melatonin, higher absenteeism, lower concentration and productivity, lower mood, higher rates of asthma, flu and headaches and higher rates of airborne viral and microbial infections.

Although not relevant to this impact forecast (which looks at daylight hours only) there are also significant problems associated with using LED lighting at night – for example in streetlights, interior lighting, floodlights and shop lights. These uses of LED are particularly implicated in melatonin suppression in humans and can also alter the behavioural patterns of animals including bats and moths.

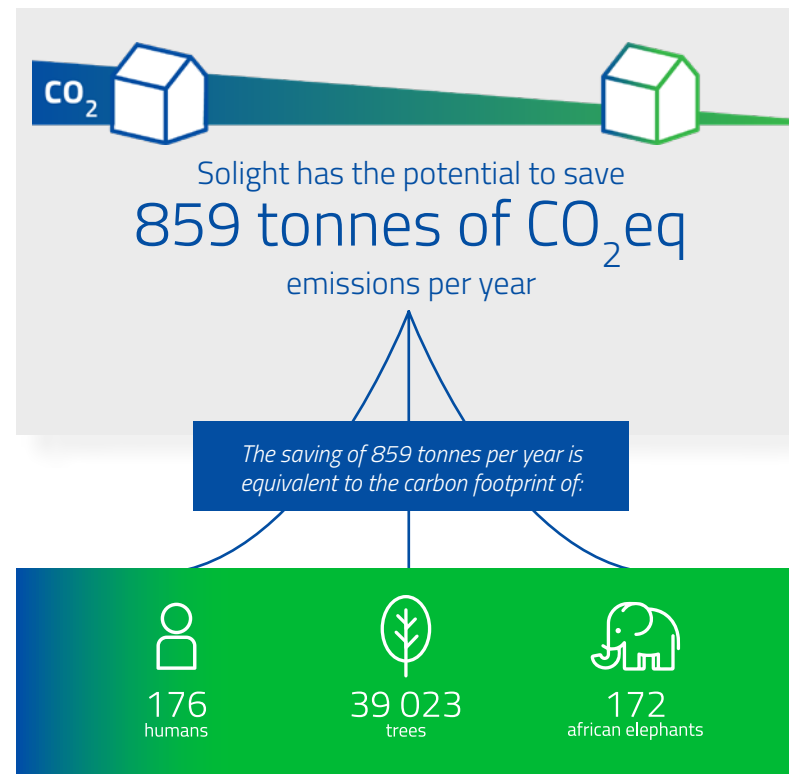
### What were the results of your Impact Shift calculations?

#### Baseline and boundaries – what was compared?

To arrive at valid climate impact comparisons, the following emissions were considered and calculated:

- emissions associated with the extraction, production and transport of materials used to manufacture Solight, including metals and glass
- emissions associated with the use and transport of Solight products, primarily as a substitute for LED lighting during daylight hours
- emissions associated with the extraction, production and transport of materials used to manufacture LED lighting
- emissions associated with the use and transport of LED lighting.

## AVOIDED EMISSIONS



*"There is an international emissions reduction competition. Investors want to improve their impact portfolios and external validation of climate impact of course carries more weight than our own inhouse assessments."*

- Ofer



# Case Study Solight

Year of Establishment: 2012

Location: Israel

[solight-energy.com](http://solight-energy.com)



Boundaries were set at 1000 SOLIS Max products in 1000 rooms of 50m<sup>2</sup> (the company's sales goal for 2024). Brightness was calculated at 30,000 Lumens Annual Daily Average for both technologies, using levels recommended in norm EN17037 for healthy natural light.

## The results

Solight came out on top; SOLIS Max products have a positive and significant impact on climate mitigation, when compared with LED lighting during daylight hours.

At a production rate of 1000 units a year, their innovation mitigates climate change with an emissions reduction potential of 859 tonnes of CO<sub>2</sub> equivalent a year.

The major driver of **positive climate impact** was the electricity that can be saved with Solight's product SOLIS Max instead of lighting by LED bulbs. The system replaces artificial lights in daytime and reduces LED usage significantly when no sun is shining. The use of 1000 SOLIS or SOLIS Max products in 1000 rooms of 50m<sup>2</sup> would save the equivalent of 348,000 LED bulbs with an assumed lifetime of five years, over daytime hours.

From a **cost reduction** perspective, the Solight system achieves a dramatic reduction in daytime lighting costs and, where relevant, air-conditioning costs. At current electricity prices SOLIS return on investment (ROI) in Europe is in the range of two to three years.

Speaking numerically, the contribution an 'average person' makes to CO<sub>2</sub>eq emissions globally, is five tonnes per year (when averaged out across high- and low-emitting countries). This means that the Solight system that was compared against LED is equivalent to sequestering the CO<sub>2</sub>eq emissions from **176** humans every year.

The savings – 859 tonnes – is also equivalent to the combined carbon sequestration of **39 023** trees.

## EU Green Deal

The EGD aims to identify and support innovations and solutions that address critical areas of emissions reduction, including transport, buildings, circular production systems, food, energy, pollution, biodiversity and finance. Solight supports two green deal goals in particular:

- The drive to "supply clean, affordable and secure energy" and
- The drive to offer solutions for "building and renovating in an energy and resource-efficient way".

## How have you used the tool and what are the benefits?

The start-up has had a much higher success rate in winning support, says Ofer Becker, since they introduced a third-party validated climate impact forecast into their pitches and bids. They can now offer numbers to describe their climate impacts in terms of extraction, manufacturing, transport and product performance – alongside the insights on health and wellbeing they had already woven into their storytelling.

"There is an international emissions reduction competition," says Ofer. "Investors want to improve their impact portfolios and external validation of climate impact of course carries more weight than our own inhouse assessments."

Solight won the European Union's Prestigious Horizon 2020 SME Phase 2 programme and is working to prepare the SOLIS system for client installations with the main points being cost-reduction, industrialization and stringent real-world testing under diverse conditions. The award effectively recommends Solight's proposal for funding by other sources.





Mobilising industry for a clean and circular economy

A zero pollution ambition for a toxic-free environment

# Case Study **TomaPaint**

TomaPaint's bio-resin could knock petrochemicals and BPA-based resins out of the food canning industry

# Case Study TomaPaint

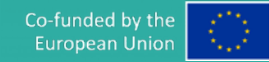
Year of Establishment: 2019

Location: Parma, Italy

tomapaint.com



Impact Shift



## TomaPaint's bio-resin could knock petrochemicals and BPA-based resins out of the food canning industry

- EIT Climate-KIC has validated TomaPaint's natural bio-resin as a positive and significant contribution to climate mitigation. It is also a healthier substitute for resins containing BPA in the food canning industry.
- TomaPaint's core business objective is the industrialisation and commercialisation of their bio-resin, which is obtained from industrial tomato processing by-products.

### What is TomaPaint's climate innovation?

TomaPaint has developed a resin derived from a waxy, water-repellent 'cutin' extracted from unwanted tomato skins. The bio-resin is a substitute for petroleum-based resins used to coat the inside and outside of cans in the metal food canning industry.

For extra circularity points, the tomato skins are a by-product of TomaPaint's local tomato processing industry and can even be used again, after the cutin is extracted, to produce bio-gas. The geographical area where the company operates is responsible for the production of 50 per cent of the tomato waste of Italy and they want to replicate their industrial plant in other regions and countries.

No BPA is needed to create TomaPaint's barrier product, unlike many petroleum-based resins.

**Eight years of research and tests show that TomaPaint's bio-resin is comparable in effect to those used in standard canning lacquers**, even over time, and in some cases is more effective.

### What are the problems and opportunities TomaPaint addresses?

Why should impact investors and metal can manufacturers care about the thin protective layer of oil-based resin used to coat metal cans today?

One, because it's the magic sauce of canning; it prevents unwanted chemical reactions between food and metal, allowing us to preserve healthy nutrient-rich food, unrefrigerated, for five years or more.

Two, because **global canning industry is expected to grow from \$27.6 billion to \$34.86 billion by 2026**. This makes canning a part of the huge secondary market for petrochemicals.

Three because most of the linings contain bisphenol A (BPA), which is already banned by some governments for human and environmental health reasons and looks set to be banned in the food industry by many more.

Four, because while canned food can't compete with organic home-grown food, it runs rings around frozen or chilled foods when it comes to carbon footprint and food waste. It is usually processed immediately after harvest, in close proximity to source, and after processing requires no further refrigeration or heat, except when the ready-to-eat contents are warmed up at home. **Steel cans can be almost endlessly recycled (if we wash and sort them properly)**.

Food canning has an important role to play in a sustainable food system, but it's not yet as healthy for people or planet as it could be.

### What were the results of your Impact Shift calculations?

#### Baseline and boundaries of the forecast

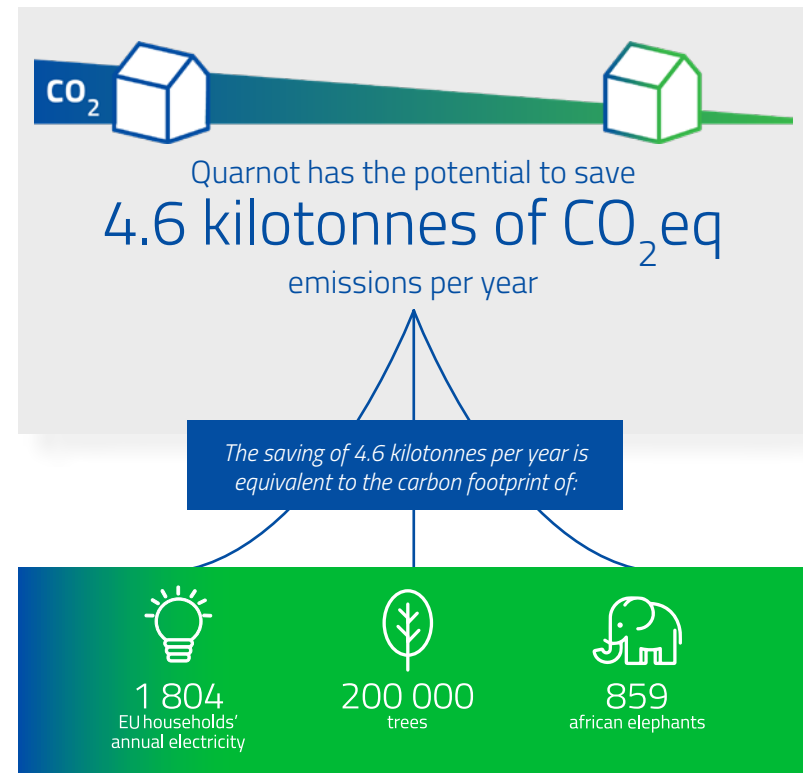
A 'business-as-usual' baseline was established using data related to the extraction, transport and production of petroleum-based feedstocks used for food can coating today.

The forecast boundaries were based on Tomapaint's capacity to produce their alternative resin in a specific location in Italy only, for distribution to canning factories worldwide. Ingredients of their bio-resin are sourced locally from industrial waste.

### The results

The forecast shows that Tomapaint has the potential to save around 21 tonnes of CO<sub>2</sub>eq for every tonne of bio-resin used. Emissions of CO<sub>2</sub>eq are lower by 730 mg for each can produced.

## AVOIDED EMISSIONS



*"Having a third-party validation of the climate impact of our product is very important to potential clients, investors and strategic partners. The validation makes our own data more valuable and the process also added new, complementary data, which is up to date and certified."*

*"Since having this forecast information our pitches and presentations have become more succinct and powerful!"*

- Angela Montanari, co-founder of TomaPaint



# Case Study TomaPaint

Year of Establishment: 2019

Location: Parma, Italy

[tomapaint.com](http://tomapaint.com)



The saving comes primarily from eliminating the need for synthetic resins, with smaller effects from savings on animal meal production using tomato wastes and avoiding landfill of tomato pomace.

This would amount to a yearly total carbon emission saving of 4.6 kilotonnes of CO<sub>2</sub>eq, which is equivalent to the yearly carbon footprint of:

- 946 average humans
- 1 935 EU households' annual electricity
- 569 times around the world in a car
- 4 645 passengers flying from London to New York
- 8 941 barrels of oil burnt or
- 921 elephants.

## EU Green Deal

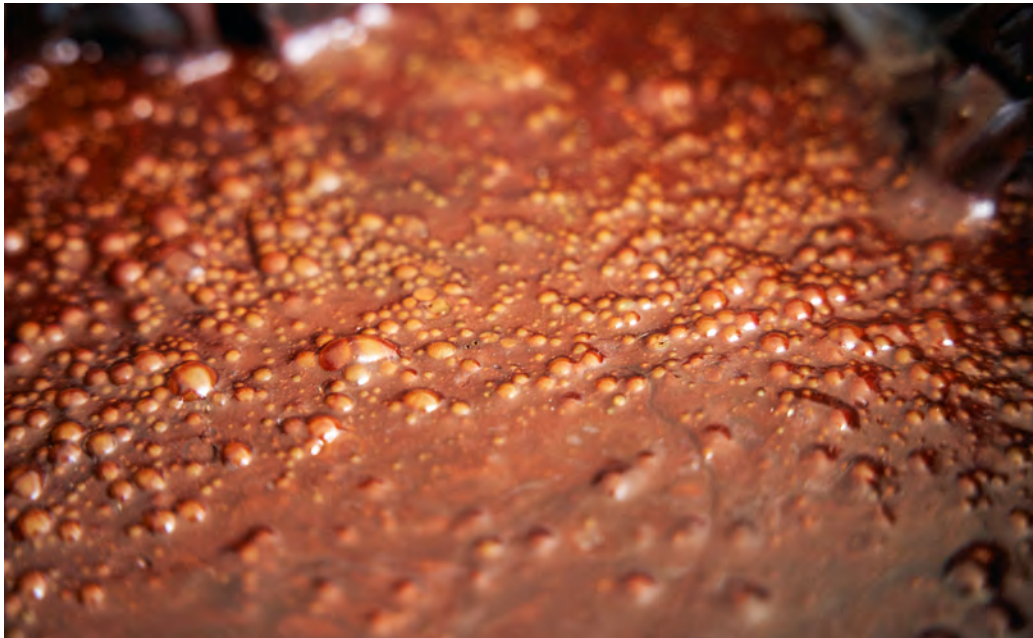
The EU Green Deal aims to change existing norms to make businesses and supply chains more sustainable. TomaPaint's contributions fall under EU targets around 'Mobilizing industry for a clean and circular economy' and 'A zero-pollution ambition for a toxic-free environment'.

## How did you use the tool and what were the benefits?

Angela Montanari, co-founder of TomaPaint says:

"Having a third-party validation of the climate impact of our product is very important to potential clients, investors and strategic partners. The validation makes our own data more valuable and the process also added new, complementary data, which is up to date and certified.

Since having this forecast information our pitches and presentations have become more succinct and powerful."





A zero pollution  
ambition for  
a toxic-free  
environment



# Case Study **Woodoo**

WOODOO aims to replace steel, concrete, glass and plastics with wood-based materials





# Case Study Woodoo

Year of Establishment: 2016

Location: Paris, France (offices) Troyes, France (factories)

woodoo.com

European  
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WOODOO aims to replace steel, concrete, glass and plastics with wood-based materials

- The start-up's nanotechnology for 'augmented wood' was developed in 2010 and patented in 2015.
- Their first product – a touch-sensitive, translucent augmented wood panel – is 87 per cent less carbon intensive than glass or plastics.

## What is WOODOO's climate-positive innovation?

WOODOO's 'augmented wood' is translucent when backlit, fire-resistant, touch sensitive and up to five times stronger than normal wood.

The company's nanotechnology was developed by Timothée Boitouzet at MIT in 2010, while on a Fulbright scholarship to Harvard University. Newly qualified as an architect, his personal mission was to help reconcile the growth of cities and a looming global housing shortage with the urgent need to decarbonise construction.

A patent was awarded in 2015 and in 2016 Boitouzet founded WOODOO which is today the 'most awarded' start-up in Europe.

### How it works

**Wood is 60 to 90 per cent air.** WOODOO's two-step process removes this air as well as lignin in the cell walls of low-grade wood and replaces it with a filling compound. This process retains the structure and grains of wood but transforms it into a new material with its own characteristics.

*"It is 23 times more rigid than concrete, and just as solid as steel."*

### Applications

Experimentation revealed unexpected applications for augmented wood.

In 2020, WOODOO launched their first product, called SLIM panels. Clients work with WOODOO to adapt the panels for a range of applications, including:

- as a replacement for silica glass panels on giant LED screen walls
- as touch- and gesture-sensitive interfaces (produced by integrating sensors under the wood) including for smart surfaces in luxury cars.

The company has also developed wood alternatives to fabric and plastics.

## What are the problems and opportunities WOODOO addresses?

### Construction and heavy industry

The steel and cement we produce today already accounts for 15 per cent of the world's CO<sub>2</sub>eq emissions. UNIDO calculates that demand for these materials will grow by more than one-third by 2050 and that to accommodate massive urban expansion as the population grows, "the equivalent of another New York City will be built every month for the next 40 years".

Boitouzet has calculated that his process will one day enable WOODOO to build 50-storey buildings – double the height of today's tallest wooden building. Construction grade WOODOO wood is in research phase at the company's laboratory.

### Regenerative materials

WOODOO uses low-grade trees such as poplars, aspens and firs from regenerative forests to manufacture their materials and is also experimenting with unwanted woods such as dead wood, diseased wood and dieback wood. Boitouzet hopes this will reduce the demand for fine woods, which grow more slowly. Woodoo is also looking into uses for the extracted lignins.

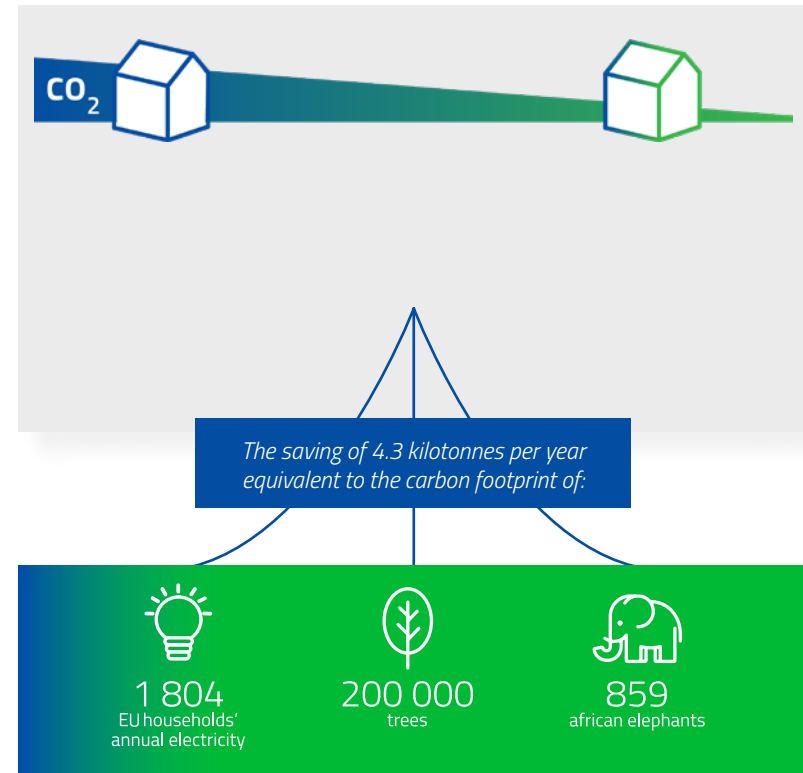
## What were the results of your Impact Shift calculations?

As a carbon-efficient materials company, WOODOO aims to help industries and corporations meet their carbon-neutrality commitments across a growing portfolio of biomaterials.

### Baseline and boundaries of the forecast

For this pilot study, WOODOO chose to calculate the potential climate impact of their SLIM materials using traditional silica glass panels as the baseline for comparison.

## AVOIDED EMISSIONS



*"Woodoo transforms wood at the molecular level. Our mission is to develop a portfolio of biomaterials for the decarbonized construction industry, amongst others. On this journey we discovered and manufacture innovative solutions: wooden screen walls, wall light panel or smart wooden interfaces.*

*We are constantly innovating around new applications for augmented wood at our own lab and with industrial partners. The Climate Impact Forecasting Tool has been an invaluable aid to experimentation, allowing us to model and test the carbon efficiency of different scenarios before decisions are made."*

- Hugo Jupile, CSR Engineer



# Case Study Woodoo

Year of Establishment: **2016**

Location: **Paris, France** (offices) **Troyes, France** (factories)

[woodoo.com](http://woodoo.com)

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Innovation  
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## The results

The company offers an alternative that has the potential to be 87 per cent less carbon intensive than silica glass.

There is potential to save around 21.5 kg of CO<sub>2</sub>eq carbon emissions with every square meter of protective cover they produce. This would amount to a yearly total carbon emission saving of 4.3 kilotonnes of CO<sub>2</sub>eq for 200 000 square metres of cover.

In a year, this saving is equivalent to the CO<sub>2</sub>eq sequestration potential of almost **200 000** trees or neutralisation of CO<sub>2</sub>eq emissions from **1 804** EU households.

## EU Green Deal

Woodoo was founded on a desire to decarbonise the construction industry. Its research is still primarily focused on the EU Green Deal objectives of 'Building and renovating in an energy and resource efficient way', 'Mobilising industry for a clean and circular economy', and 'A zero-pollution ambition for a toxic-free environment'. Their approach to sourcing wood aligns with the EGD objective of 'Preserving and restoring ecosystems and biodiversity'.

## How did you use the tool and how did it benefit you?

Hugo Jupile, CSR Engineer says:

"Woodoo transforms wood at the molecular level. Our mission is to develop a portfolio of biomaterials for the decarbonized construction industry, amongst others. On this journey we discovered and manufacture innovative solutions: wooden screen walls, wall light panel or smart wooden interfaces.

We are constantly innovating around new applications for augmented wood at our own lab and with industrial partners. The Climate Impact Forecasting Tool has been an invaluable aid to experimentation, allowing us to model and test the carbon efficiency of different scenarios before decisions are made."

