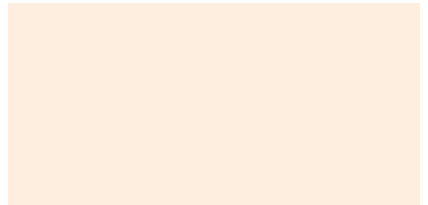
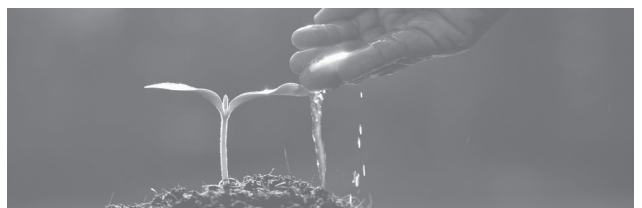
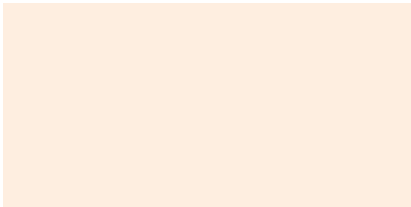
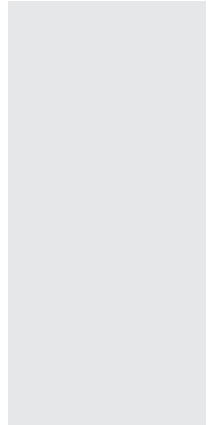


Jacobi's Sustainability Report



Life Cycle Assessment



Our Journey

Here at Jacobi we have been thinking about sustainability and focusing our efforts on becoming a more sustainable company for several years now. We, much like the global population, organisations and individuals alike, realise the importance of taking care of our planet and preserving its resources. We understand that it is vital for us to operate in the most sustainable way possible and to limit our negative effects on the planet wherever possible too. Our activated carbon products are designed to solve our customers' current problems and this is always our objective, however, we must ensure we do this whilst also considering future generations. We are a global business and we recognise the responsibility that comes with this.

Currently, our main goal is to become the most sustainable supplier in the industry – not just for activated carbon, for our ion exchange resins and services businesses too. It's a big ambition and it will certainly take time but we have already begun taking steps towards this. At Jacobi we understand that to truly achieve sustainability, we will need to dig a little deeper than simply meeting the standard requirements. We have implemented several initiatives already that have each brought us a little closer to our goal. For example, harvesting rainwater, making recycling easily available to our employees, and using electricity over diesel to power equipment. One of the most significant factors in our journey is our focus on renewable raw materials, in particular, the coconut. To gain an in-depth insight into how we could progress even further, we felt it was necessary to conduct a full study into the effects of our carbon production.

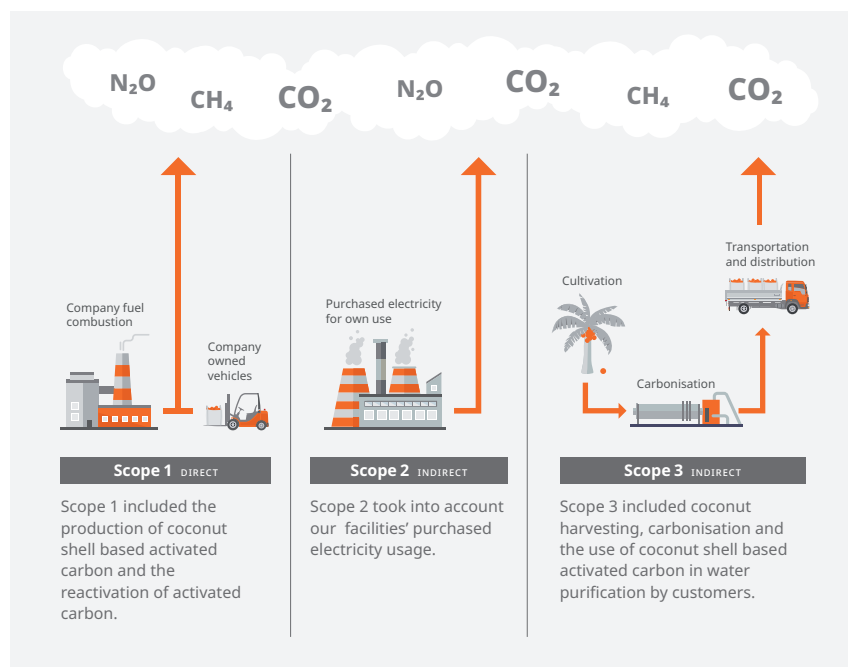


Having spent many years developing our production of activated carbon, we're proud of what we have achieved so far. Today we are the largest producer of coconut based activated carbon. Moving forward, we are fully dedicated to our goal of becoming the most sustainable activated carbon supplier.

The Life Cycle Assessment

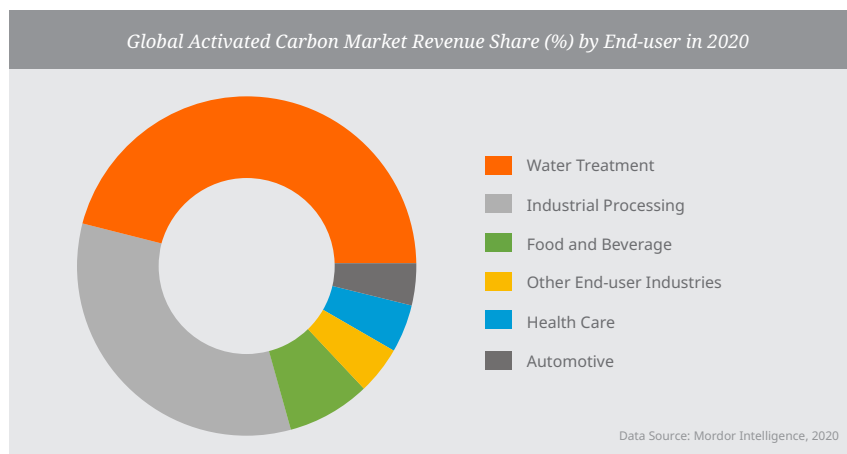
We recently worked with Maastricht University on a life cycle assessment, or LCA, of our activated carbon business. This is a method used to measure the environmental impact of a product throughout its life cycle. It encompasses all stages: extraction of raw material, production, use, and disposal or recycling. The process allows you to see which areas are being excelled in and which aspects could be improved to be more environmentally friendly.

In order to make our calculations, the study is split into 'scopes', in this case three scopes. *Scope 1* (direct factors) covering primary production and the reactivation process of activated carbon. *Scope 2* (indirect factors) such as energy and utilities usage during the primary production process. And finally,



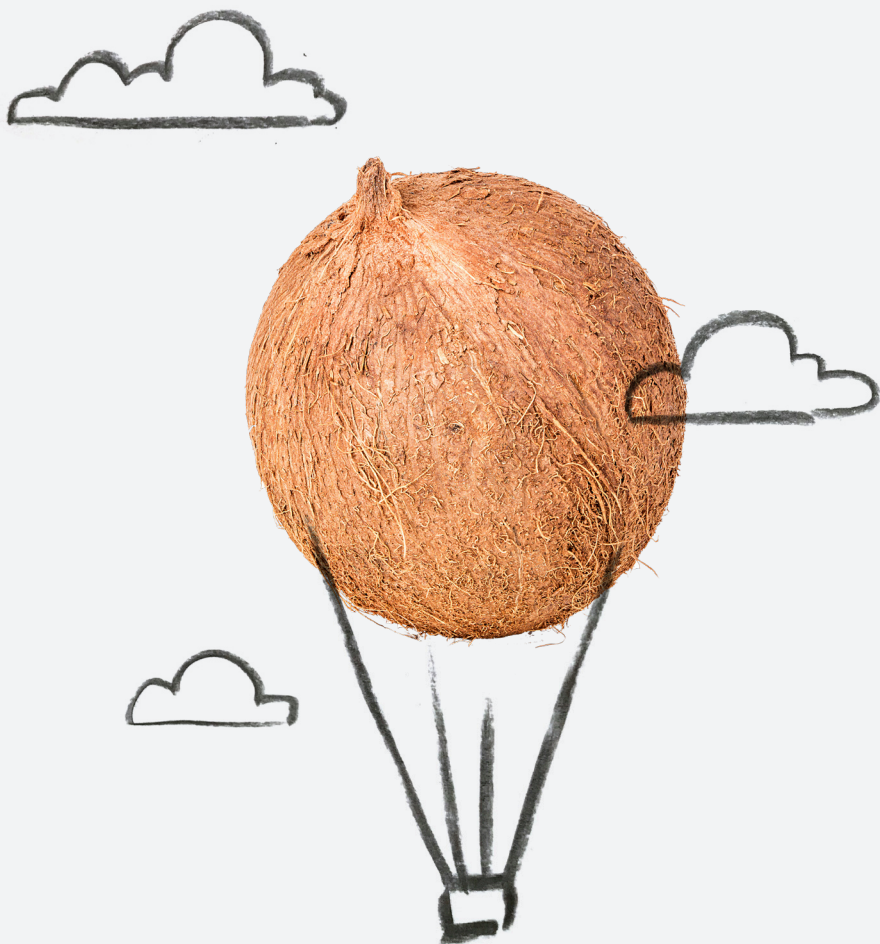
To make calculations, the LCA study, conducted by Maastricht University, was based on the three scopes above.

Scope 3 (also indirect factors) raw materials and customer application. Some are the direct impact factors which we have a certain level of control over and others can be indirect factors that occur as part of the business.



Rather than hiring an environmental consultancy, we chose to work with a university and avoid any potential commercial influence and the use of basic, standard modelling. The team at the university analysed the life cycle of 1MT of coconut shell activated carbon used to treat drinking water in municipal water plants. Technical specifications and requirements mean that we do sell activated carbon made from raw materials other than coconut shell, however, coconut shell based activated carbon is 95% of what we produce and so this was chosen to be analysed.

We chose the application segment for water because according to a market report (Mordor Intelligence, 2020), the global activated carbon (AC) consumption was at c.a. 1666 kiloton in 2020. As shown in the chart above, the largest user of this product is the water treatment sector, so it made sense to do our own modelling around this sector.



In 2004 we built our plant in Sri Lanka. At that time the business wasn't really talking about sustainability, but today it is at the forefront of our minds and is now the focus of our journey. We want to inspire the industry to become more sustainable, so we can build a better future for people and our planet.

Assessment Findings

OUR CO₂ POSITION TODAY

When we set out on this study we wanted to ensure that our modelling method was data driven and customised to our business. We continue to develop this moving forward as we explore the different scopes of the study and continue to optimise our production and business practices globally.

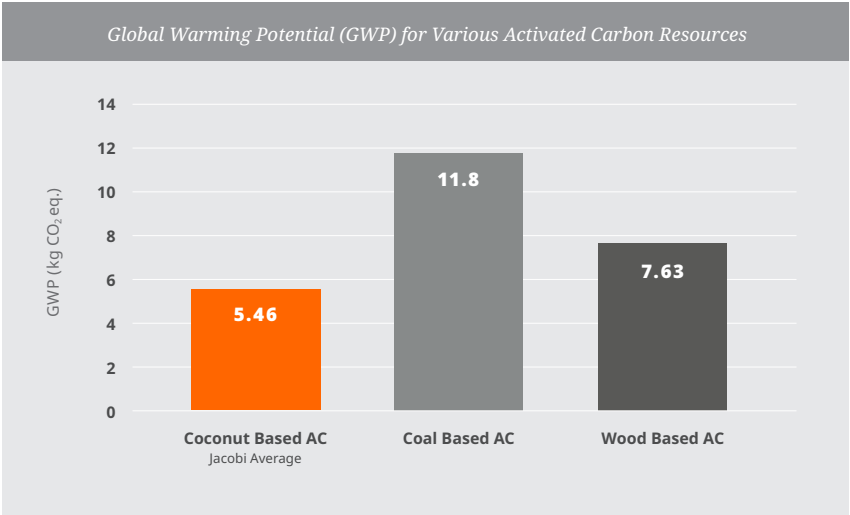
CURRENT SITUATION - GREENHOUSE GASES AND GLOBAL WARMING POTENTIAL

As part of the study we wanted to take a measurement of where we stand today with *Scope 1*'s direct factors and *Scope 2*'s indirect factors. There are many different ways to measure these scopes, but the main measurements we look to get a handle on are our greenhouse gases (GHG) levels which in turn give us our global warming potential (GWP) measure.

The results of our study are divided into different aspects that we have modelled in order to build a picture of our position today.

COCONUT VS COAL VS WOOD BASED ACTIVATED CARBON

Based on the output of our plants, we were able to calculate the GWP of 1 kg of virgin activated carbon with a ‘cradle-to gate’ view. This means the journey of our product from production in our plants in Asia to the customers we hold in Europe.

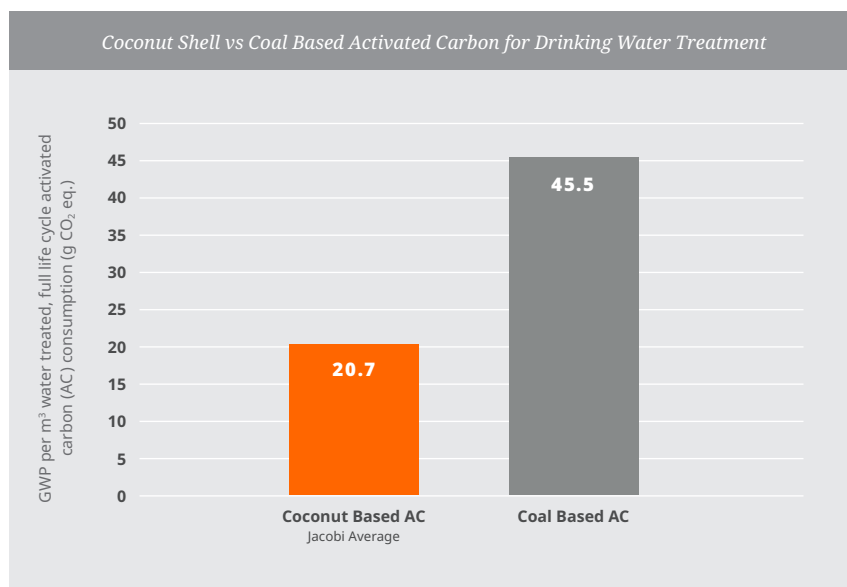


The graph shows a significant decrease in GWP with coconut based AC.

From the study, we can observe that the gap between the coconut AC and the coal AC is about twofold. As the system boundaries and modelling extends to a ‘cradle-to-grave’ approach, which works with the product from its production to its end of life, it is expected that this gap will be further increased because the coconut AC loss is finished as biogenic CO₂ which is theoretically carbon neutral.

COCONUT VS COAL ACTIVATED CARBON FOR DRINKING WATER TREATMENT

As illustrated in the below graph, for 1 m³ water treatment, the use of coconut AC sees the GWP reduced by 54% in comparison to coal AC, a significant reduction. Also, it can be observed that as the system boundaries extend from cradle-to-gate to cradle-to-grave again, the gap between the coconut AC and coal AC is further increased. This is because a cradle-to-grave study can give a more complete picture of a material's GWP from a full life cycle perspective.



Global warming potential (GWP) of treating 1 m³ of drinking water by using different activated carbons. The approach is cradle-to-grave and the value is reported in g CO₂ eq.

Coconuts as a Raw Material

The life cycle assessment (LCA) showed us that coconuts, in terms of sustainability, are an excellent raw material, particularly in comparison with the prominent alternatives. Coconut harvesting occurs regularly, with coconuts taking just six months to fully form, and they are an easily renewable and accessible source. The difference with other raw materials, for example coal, which takes millions of years to form, or wood which takes decades, is stark. The coconut trees themselves also capture CO₂ from the atmosphere, helping to contribute to the global efforts to decrease the CO₂ levels in the Earth's atmosphere.

The coconut is harvested primarily as a food source and the part we use is actually a byproduct of the food industry. By using it to produce carbon, we prevent it being wasted and potentially being burnt as fuel. In fact, every part of the coconut has a use and there is no waste. The water, meat, husk and shell are all used across various industries.

*Time Span of Activated Carbon Raw
Material Formation*



Coal: 2,000,000 years



Wood: 20 years



Coconut: 6 months

THE HUSK

The husk, which encloses the coconut kernel, has a variety of uses ranging from organic fertilisers and building materials to recyclable packaging and brooms.

THE SHELL

The hard shell of a coconut is the most sustainable raw material for creating activated carbon. The shells Jacobi uses are a waste product from the food industry.



THE MEAT

Coconut meat is the white flesh found inside the coconut. Also called the kernel, it is edible and can be eaten fresh or dried.

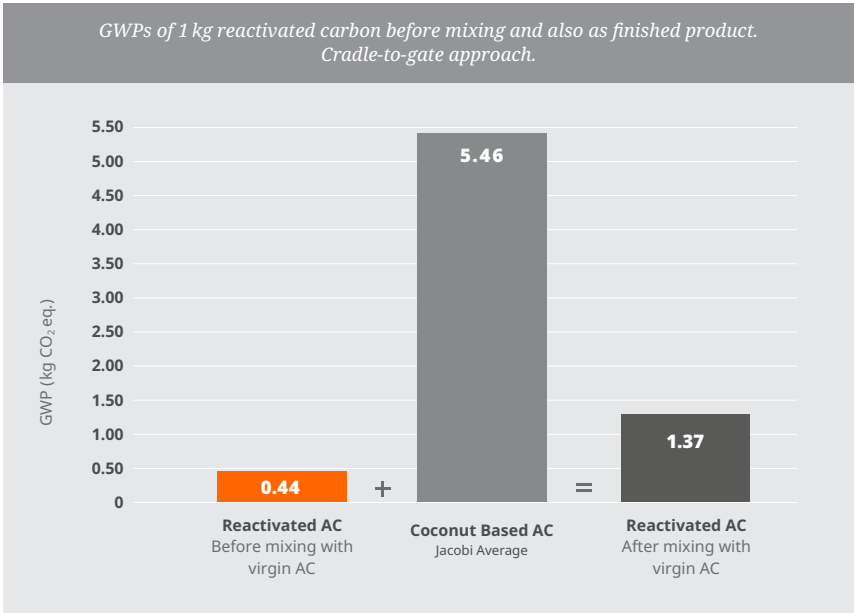
THE WATER

Coconut water is the clear liquid found inside the coconut. The water has rapidly risen in popularity as a drink over the past two decades.

Reactivation

TODAY'S SNAPSHOT

One of the major benefits of activated carbon is the ability to recycle it through a process called reactivation. Jacobi offers reactivation services in Europe with plans to expand in the coming years. Customers treating potable water, process water, industrial wastewater and various vapour phase emissions utilise our reactivation services. Reactivation offers economic benefits but equally important is its impact on CO₂ emission.



The graph shows the average GWP from the reactivation of spent carbon to produce 1 kg of reactivated carbon and 1 kg of carbon with approximately 20% make-up from virgin coconut based activated carbon. The reactivated carbon plus virgin make-up contributes 1/4 of the GWP as compared to production of the same quantity of virgin carbon, which demonstrates the value and ability to reactivate coconut based activated carbons.

Production Processes

To take the coconut shell from raw material to activated carbon, it must go through the carbonisation and activation processes. We have worked on several clean technology (technology that is kinder to the environment) initiatives to ensure that we are using the most sustainable methods possible and the life cycle assessment has allowed us to see the benefits of these.

We have equipped our factories with modern rotary kilns for steam activation. These new kilns operate almost entirely without the use of fossil fuels. Instead, we re-use waste heat from our own processes and, as a result, have been able to vastly reduce our CO₂ emissions.

Throughout production, a great deal of heat is necessary. Even when we reuse this energy, there is still some leftover that can be used to generate power used in *Scope 2* based activities. This counts towards our *Scope 3* initiatives too; the cleantech carbonisation processes will also allow us to use the excess heat and turn it into electricity.

Coconuts have so many uses that the coconut tree is often nicknamed the tree of life. It takes just six months for a coconut to fully form and the trees can continue to produce coconuts for up to 100 years.



Our Future with Clean Technology

In the next few years, we will continue to focus on investment and innovation in clean technology. We expect this will also involve strategic partnerships that will allow us to facilitate the implementation of the cleantech carbonisation future.

Currently, we buy charcoal from our charcoal partners who use a conventional carbonisation process to produce it (“modern pit”). In *Scope 3*, we see great potential to introduce clean technology to ensure that we are using the most sustainable methods possible and the life cycle assessment has indicated the potential benefits in terms of GHG emission reduction.

We are developing two types of cleantech carbonisation process: a batch process developed together with a partner, and a continuous process technology. Depending on the type of partner (size, core business), a batch process or rotary kiln process is more suitable. Both processes secure full oxidation of off-gases and enable using excess heat to generate electricity for use (especially in *Scope 3*).

After having fully developed the cleantech carbonisation technologies in *Scope 3*, we plan to make it broadly available to our charcoal supply partners

through licensing agreements, aiming to make the carbonisation industry throughout Asia more sustainable.

As well as our new cleantech innovations we are taking a firm look at our on-site energy usage with a move to greener sources and renewable energies, such as solar power being made wherever possible. We are aiming to move to making all of our electricity usage renewable.

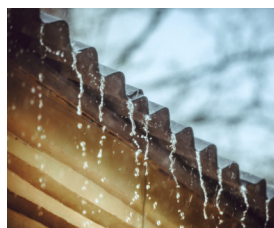
It is worth noting that we have only covered *Scope 1* and *2* to date in this study, which involves our direct and some indirect process factors. We will also be investigating *Scope 1* and *2* further, processes we are indirectly involved with, and making those more environmentally friendly also.



Our new kilns operate mainly from re-used waste heat which vastly reduces our CO₂ emissions.



Cleantech: The GreenEco Furnace limits emissions of greenhouse gases.



We collect rain water to be used in production processes.

Join Our Journey

Whilst we are ultimately pleased with our steps towards becoming more sustainable, we know there is still some way to go. As the main coconut shell-based company, we have built strong foundations for a sustainable future and are certainly on the right track. As mentioned previously, not everything we produce is made from coconut shell. We do also manufacture a small amount of activated carbon from wood and coal when technical requirements dictate it is necessary. Moving forward we hope to perfect our coconut shell based products so that they can be used in every application and eliminate the use of coal and wood as raw materials.



Innovation never stops with Jacobi Group.

Our research and development teams are constantly working behind the scenes on new methods and processes that could make our business even further sustainable, improve our production yield for the resources we use currently, and innovate for a more sustainable future. As well as this, we are implementing a dedicated team to monitor our life cycle analysis across the business and find ways to minimise our environmental impact and decrease our global warming potential. We aim to continue to see improvements year on year and will report back on these.



Completing the life cycle assessment has confirmed the sustainability credentials of the humble coconut as a raw material. Compared with coal based activated carbon, the global warming potential of coconut based activated carbon is up to 62% lower, which is great news for our planet.



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