Activated Carbon:

Why Coconut Shell Feedstock Leads on Climate Performance

SUSTAINABLE COCONUT PARTNERSHIP

This brief was developed by the Sustainable Coconut Partnership (SCP), as part of a research project on the sustainability credentials of coconut shell activated carbon and barbecue briquettes. Under this project, independent environmental and life cycle assessment experts 2-0 LCA were commissioned to carry out research on GHG emissions, to ensure methodological rigour. Financial support was provided by two SCP member companies: Jacobi Carbons and Fritz Schur Consumer Products. These companies also contributed technical inputs and data to inform the analysis. This brief provides an in-depth exploration of GHG emissions for coconut shell activated carbon.

In a nutshell

- **The data showed that coconut shell activated carbon has lower emissions than coal-based activated carbon.** This varied from 31–68% lower, depending on the charcoal production method used
- **There is a pathway to reach a 79% emissions reduction for coconut shell activated carbon,** through cleaner charcoal production
- **Coconut-based solutions deliver best-in-class climate performance,** with forward-thinking industry leaders developing and deploying cutting-edge, low-emission technologies across coconut shell activated carbon value chains

Research Scope

The Sustainable Coconut Partnership (SCP) works towards a responsible and resilient coconut sector. Amongst the SCP's Members are some of the leading manufacturers of coconut shell-based activated carbon and charcoal briquettes - products with growing relevance in the circular and low-carbon economy.

This study provides an evidence-based assessment of the climate credentials of coconut shell-based activated carbon and highlights key opportunities for reducing GHG emissions.

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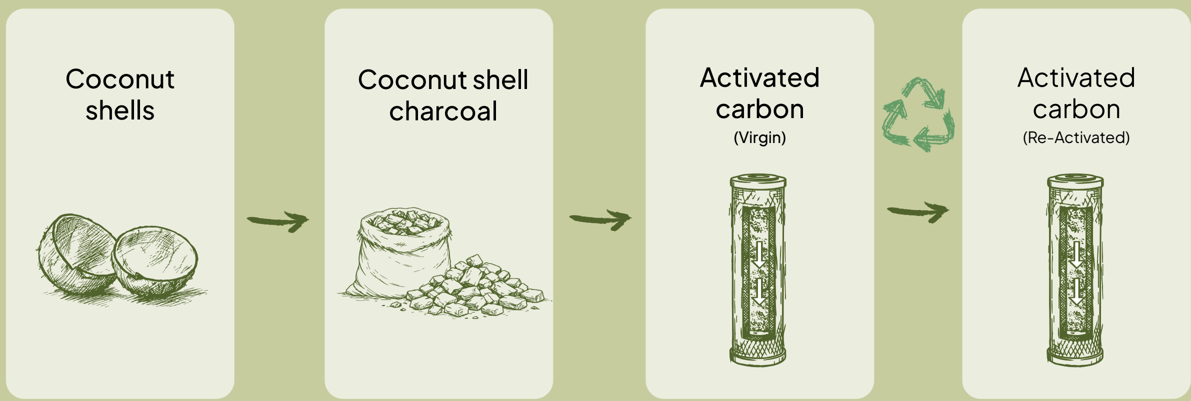
What is coconut shell activated carbon?

Coconut shell activated carbon is a **natural filtering material**. Widely used for purifying air and water, **it helps ensure cleaner air, safer water and improved public health, benefiting both individuals and society at large.**

The main **raw material is coconut shell charcoal**, which is heated with steam or natural gases that create millions of tiny pores. Coconut shell activated carbon has a very high number of micropores, making it **especially effective at adsorbing small molecules and contaminants**.

Another interesting feature of coconut shell activated carbon is that, once spent, it can be **recycled through a process known as 're-activation'.**

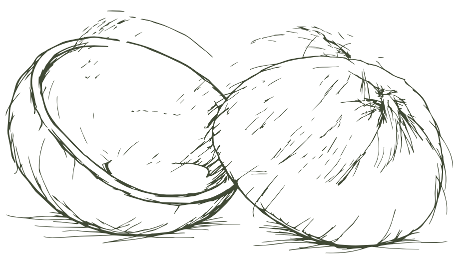


A growing body of work supports the sustainability credentials of coconut shell-based activated carbon, including detailed life cycle analyses of GHG emissions conducted by industry actors such as Jacobi Carbons. To further evaluate and validate these findings, an independent assessment was commissioned by SCP in 2025. This work was carried out by independent environmental and life cycle assessment experts 2-0 LCA. The findings presented in this brief provide a comprehensive assessment of GHG emissions associated with coconut shell activated carbon.

The analysis in this research covered:

- Calculation of GHG emissions for coconut shell-based activated carbon, through a Life Cycle Assessment (LCA) process, using the best available data.
- Identification of the biggest sources of GHG emissions for coconut shell based activated carbon and opportunities for reducing these emissions.

This analysis is critical to help the sector to accelerate its journey to a low carbon or net zero future.



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Approach and methods for emissions assessment

Finding the best sources of data

The assessment began with a systematic review of available data. Eleven studies were considered, comprising peer-reviewed literature and confidential industry reports shared with SCP. The quality of each data source was evaluated and only datasets of a sufficient standard were used in the analysis.

This included pioneering data on emissions from coconut shell charcoal production, gathered by Jacobi Carbons through an in-depth study which involved direct measurements at sites employing a wide range of production technologies. It also included data on emissions caused by coconut-related deforestation and peatland conversion. This data was generated through SCP's Deforestation Monitoring Initiative, based on satellite mapping of coconut-related deforestation and peatland conversion. These were then complemented by a series of additional data sources, including EXIOBASE 3.3.16, Ecoinvent database v.3.9.1. Agrifootprint, and previous LCAs generated by 2–0 LCA.

Covering key producing countries

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Representing the full range of real-world charcoal production technologies in the analysis

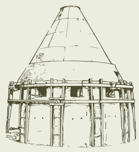
The charcoal used to make activated carbon can be produced through a range of technologies, from simple open pits to cutting-edge technologies such as Jacobi's Rotary Carboniser. One major way in which these technologies differ is the extent to which they control methane emissions during charcoal production. When carrying out our LCA, it was essential to take these differences into account, because the GHG emissions for each technology vary greatly. To do this, we categorised these technologies into 4 groups (below) and calculated the GHG separately for each group.

Group 1

Drums,
Open Pit,
Chula

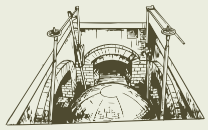
Group 2

Closed Pit, Vertical Retort and Modern Pit (partial combustion)



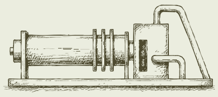
Group 3

Modern Pit and Elevated Pit (full combustion)



Group 4

Rotary Carboniser (Jacobi technology)



Low control of methane emissions

- Limited capture of methane, meaning that a lot is released
- Incomplete burning of methane

High control of methane emissions

- Capturing more methane instead of releasing it
- Burn methane more completely

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Coconut shell feedstock leads on climate performance

Up to 68% lower emissions than coal-based activated carbon

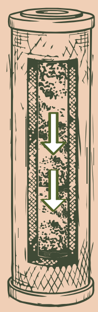
This study calculated the GHG emissions figures of coconut shell activated carbon in several ways:

1. GHG emissions per Kg of activated carbon produced
2. GHG emissions per Kg of activated carbon produced and reactivated as many times as possible for filtering water
3. GHG emissions generated to filter a given amount of water

Each of the above were also calculated using both consequential and attributional approaches to life cycle modelling[1]. In all cases, the data showed that the emissions for coconut shell activated carbon were lower than for coal-based activated carbon. The third analysis is arguably the most insightful, because **it helps us to understand the emissions generated for a given unit of service – in this case water filtration**. Different types of activated carbon can filter different volumes of water in their life cycle - this analysis accounts for that difference.

What stands out from these results is that:

- **Coconut shell activated carbon has lower emissions than coal-based activated carbon** in all groups of coconut shell charcoal production
- **With the greenest technology, emissions are 68% lower than coal**



[1] See this page for technical descriptions of the consequential and attributional approaches to life cycle modelling.

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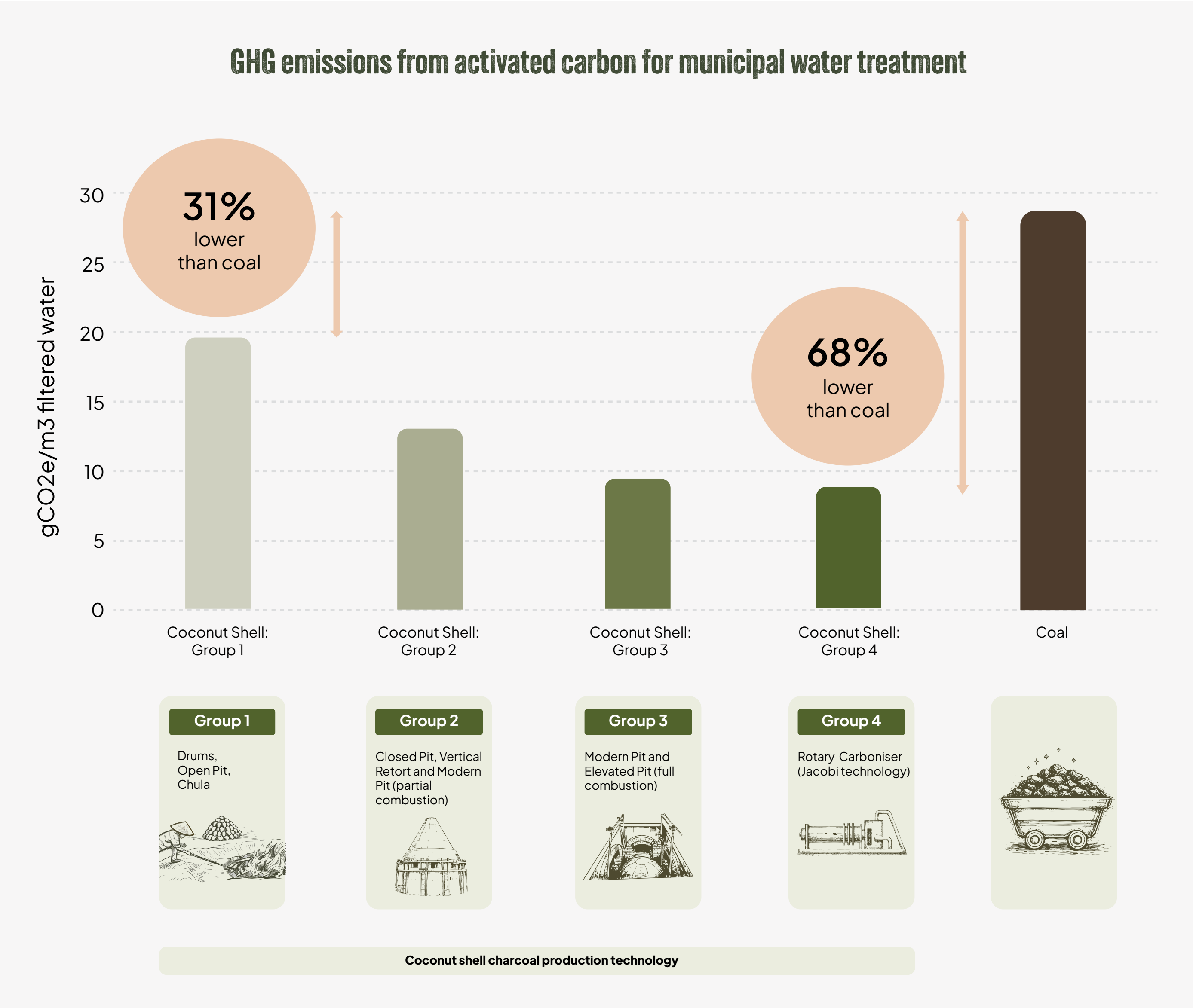
The graph below shows the GHG emissions of activated carbon produced using coconut shell charcoal made with the four different types of technology we explained above. For comparison, we also present the emissions when coal is used instead[2]. These results are calculated as the GHG emissions generated by activated carbon that will filter 1m^3 of drinking water in a municipal treatment facility. This includes all emissions for the supply of charcoal, activation, transport and reactivation.

Figure 1: GHG emissions from water filtration using activated carbon based on coal and coconut shell, calculated using the consequential approach. These figures assume that coal and coconut shell have the same performance for water filtration. Specific activated carbons may perform differently with variations in water quality and treatment parameters



[2] The coal figures are calculated for production in China and use in the EU. The activated carbon figures are calculated for the average for production in the Philippines, Indonesia, India and Sri Lanka, and use in the EU

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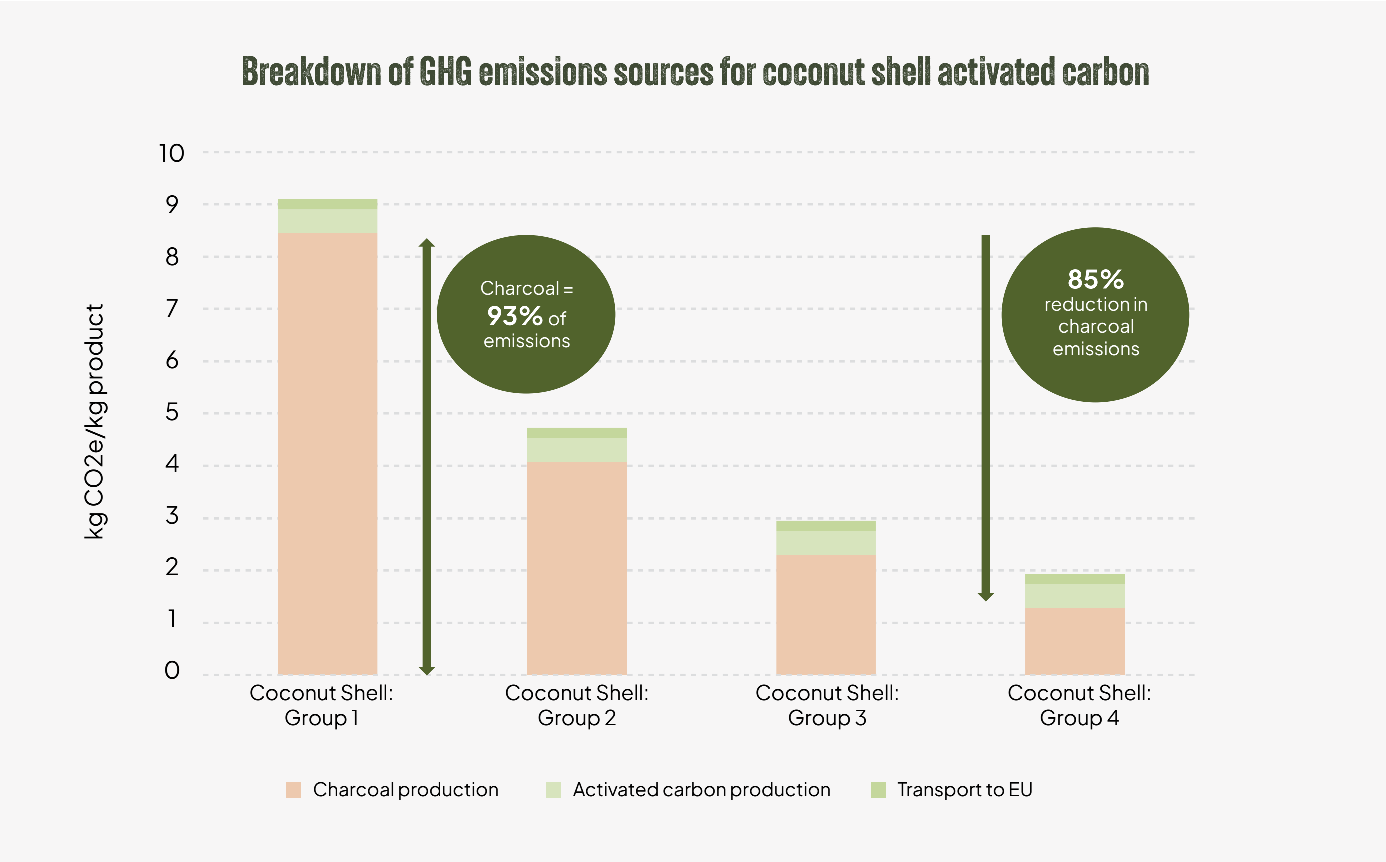
The pathway to a 79% emissions reduction: cleaner charcoal

The study identified opportunities for further reducing GHG emissions for coconut shell activated carbon. To do this, the research took a deeper look at the main sources of emissions: the production of the raw material (coconut shell charcoal), and the production and transport of coconut shell activated carbon[3].

The graph below presents a breakdown of these sources. As we can see, **production of coconut shell charcoal is by far the biggest contributor**, responsible for 93% of emissions for coconut shell activated carbon for Group 1 technologies.

Figure 2: Breakdown of GHG emissions sources for coconut shell activated carbon (KgCO2e/Kg activated carbon), calculated using the consequential approach.



The great news is that the greenest technologies for coconut shell charcoal production (Group 4) are able to cut these emissions by 85%, which reduces the total emissions for activated carbon by 79% compared with Group 1 technologies.

With this data in hand, the pathway to a low carbon future is clear and companies will achieve the greatest emissions reductions by shifting to greener charcoal production technologies. **Aside from cutting GHG emissions, the adoption of cleaner carbonisation will also reduce emissions of other pollutants into the atmosphere, such as particulate matter or carbon monoxide**.

[3] GHG emissions for coconut shell activated carbon production were calculated based on Jacobi's clean activation process. Other activation processes used will generate different levels of GHG emissions.

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From pioneer technologies to scalable industry solutions

Leading companies within SCP's Membership are already taking steps to further reduce emissions from coconut shell charcoal production. For example, Jacobi Carbons has developed both batch and continuous cleantech carbonisation technologies, that enable full oxidation of off-gases and produce excess heat which can be used to generate steam or electricity.

Beyond in-house deployment, Jacobi plans to make these technologies available to charcoal supply partners and coconut industries through licensing models, supporting broader industry uptake. This demonstrates that there are clear pathways for the scale up of low emission coconut shell charcoal production technologies, which will generate significant reductions in emissions for the sector.

Securing the future of coconut shell through responsible rejuvenation of the coconut sector

Coconut shells represent a highly valuable renewable feedstock with strong sustainability potential, particularly when sourced through responsible and traceable supply chains. Maintaining these positive environmental and social outcomes, however, requires continued investment in the long-term resilience of coconut farming communities. In several producing regions, the sector faces challenges linked to aging tree populations, low productivity, and insufficient replanting efforts[4]. Supporting farmers through farm rejuvenation, improved practices, and sustainable supply chain initiatives is therefore essential to ensuring the long-term availability, quality, and sustainability credentials of coconut-based materials. The Sustainable Coconut Partnership (SCP) brings together stakeholders across the coconut value chain to help drive this transition and strengthen the future resilience of the sector.

SUSTAINABLE COCONUT CHARTER

[4] Sustainable Coconut Partnership (2025). Pulse of the Sector: The Coconut Industry's Sustainability Report. Observations, Trends, Solutions to the Industry's Sustainability challenges

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The Sustainable Coconut Partnership (SCP) unites stakeholders across the coconut supply chain to build a responsible and resilient coconut sector. Guided by a Charter developed by its stakeholders, SCP enables its members to adopt best practices and deliver measurable results - improving farmers' livelihoods, protecting nature, and managing the impacts of climate change.

www.coconutpartnership.org

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