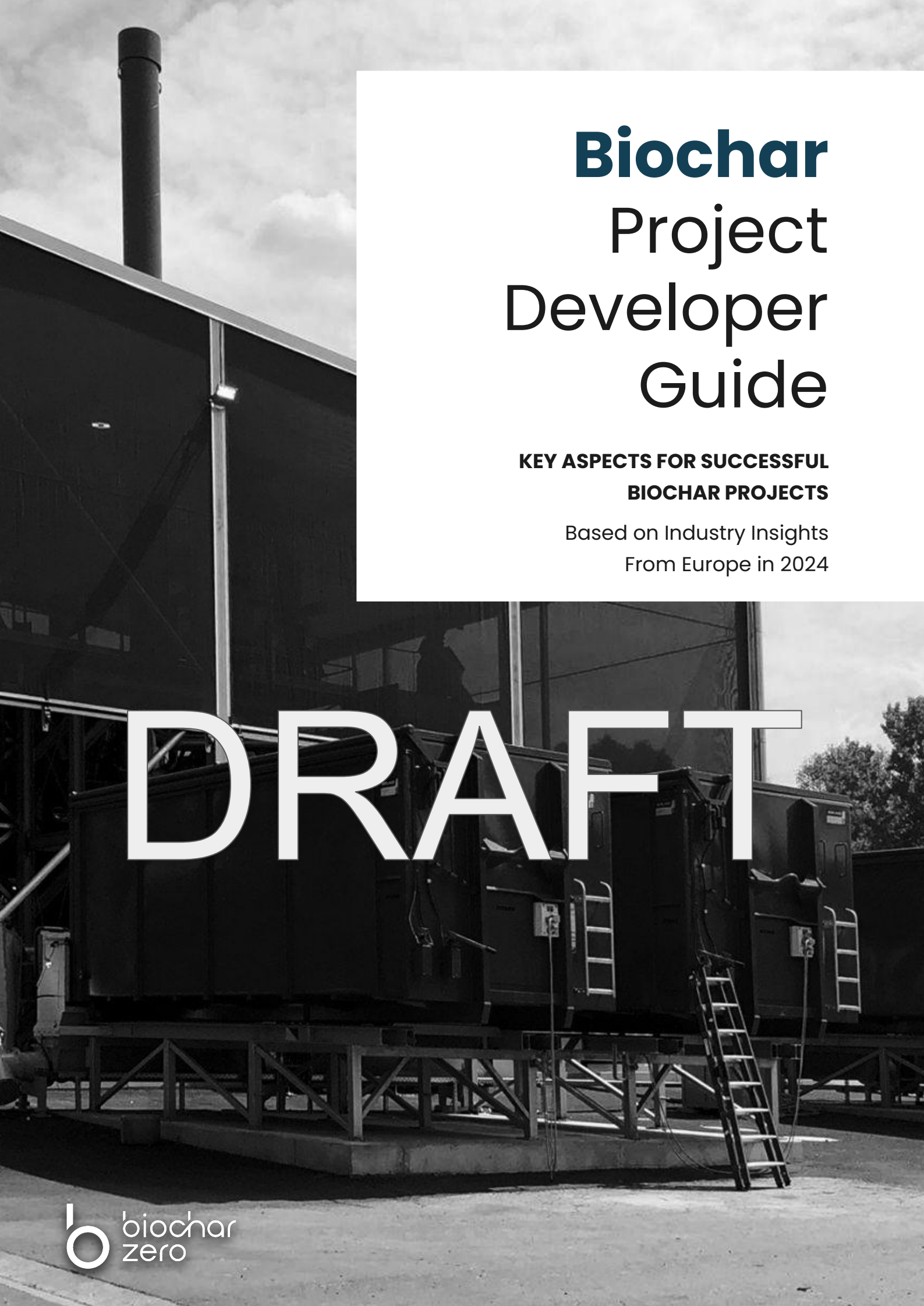


Biochar Project Developer Guide

KEY ASPECTS FOR SUCCESSFUL BIOCHAR PROJECTS

Based on Industry Insights
From Europe in 2024

DRAFT

biochar zero

Unlocking biochar production: A comprehensive guide for industry leaders to drive profitability and combat climate change

Many organisations currently research how they can operate more sustainably without losing their competitive advantage. **Pyrolysis** with the production of biochar, energy and carbon credits is frequently discussed as an **option for decarbonisation, circular economy, and defossilisation**. This is especially true for organisations with a high demand for heat, available residual biomass, or greenhouse gas emissions originating from raw material processing.

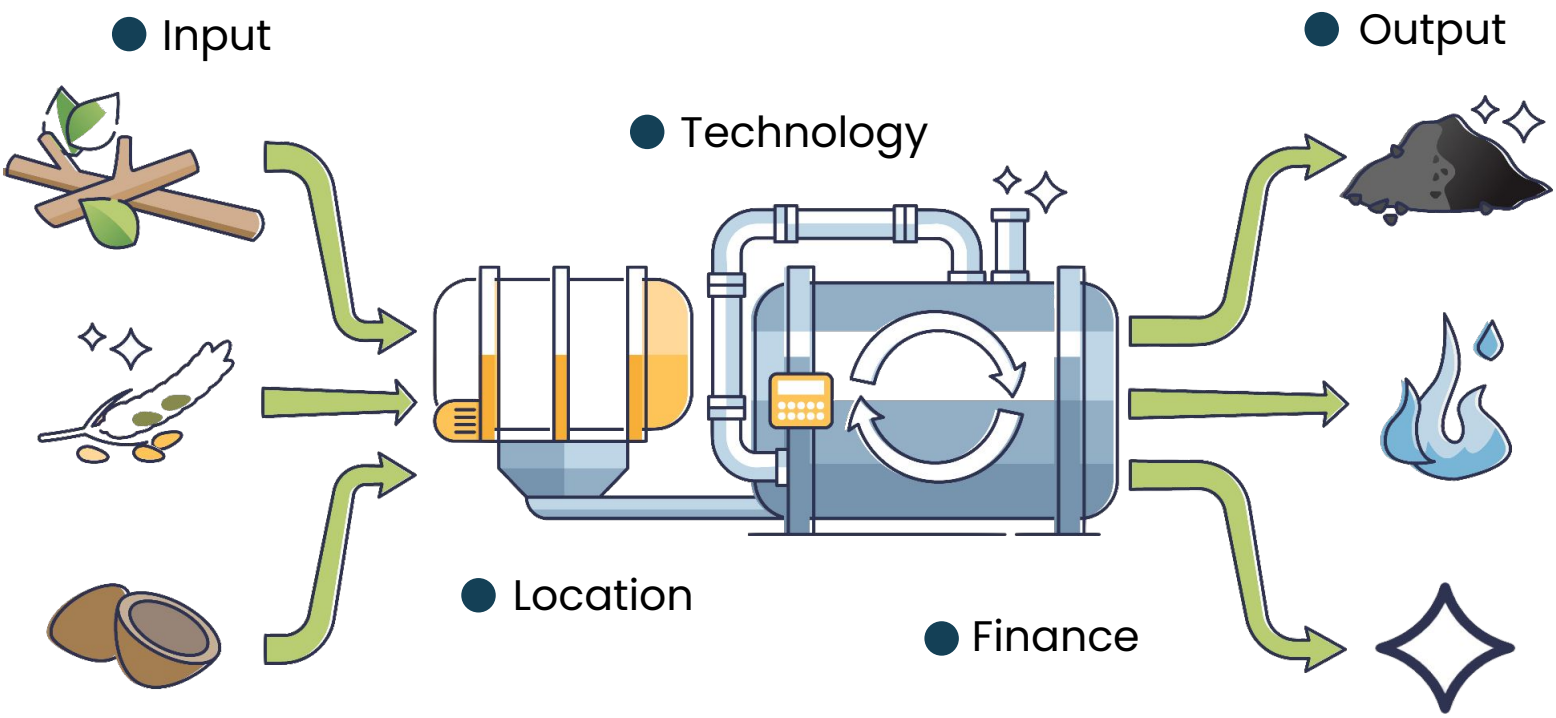
To understand the impact and use of this technology, organisations perform further research to come up with a business case, which this guide will support.

We demonstrate different ways how you can **produce biochar economically** to reduce, offset, and/or inset emissions and act against climate change.

This guide will help you make key decisions within the five core areas of a biochar production.

We are a consultancy for biochar, with three years of domain experience. Recently, we performed a market study about profitable biochar production at industry scale in Europe, whose results are incorporated in this guide.

Let's dive right in!

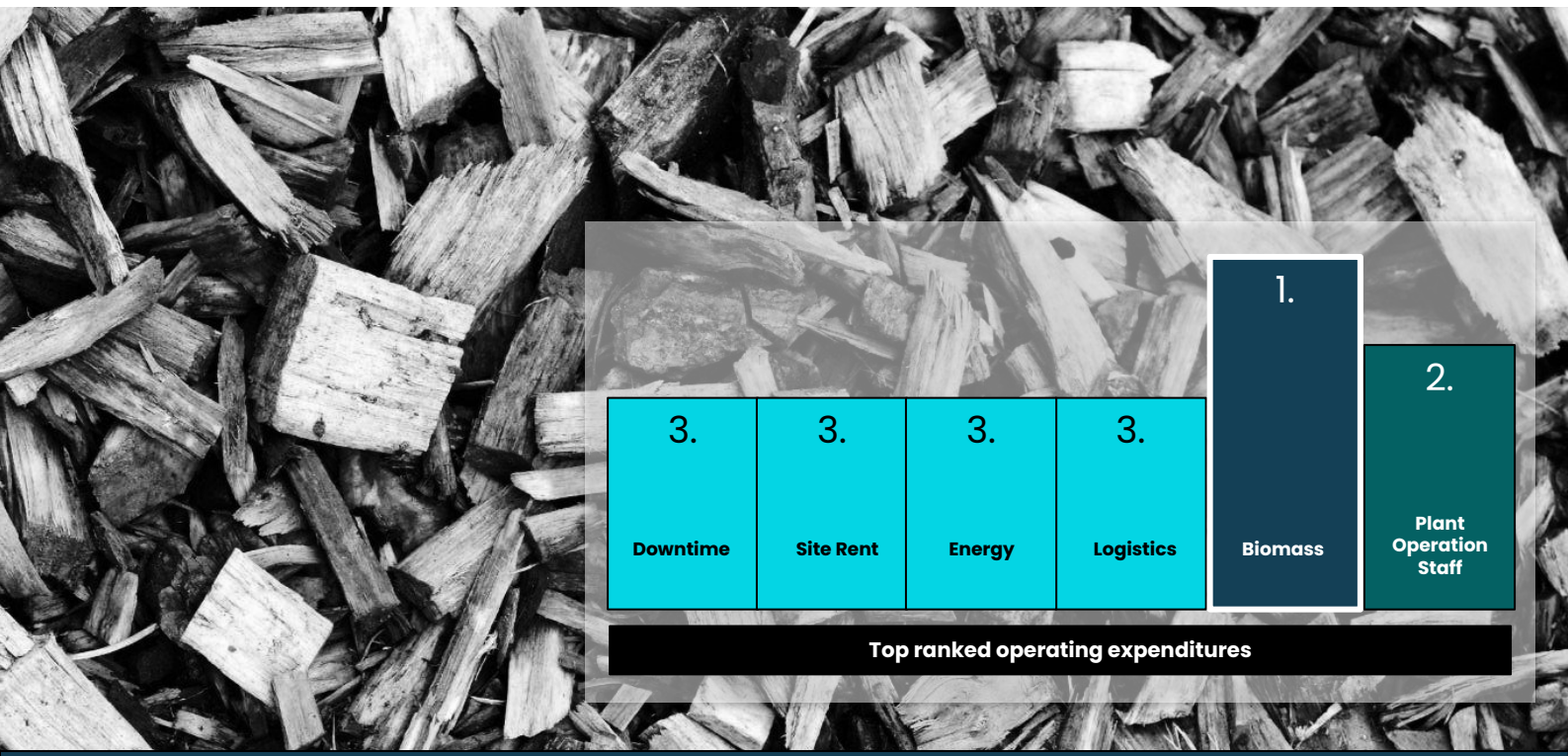


Controlling your most critical operational cost factor: **Biomass**

Biomass accounts for the **largest fraction of operating expenses** for most producers. Whether sourced internally, or externally within 50 km to max. 100 km radius, is not a key differentiator for a profitable biochar business. Externally sourced biomass comes with higher price variations which your business model needs to account for. This is to remain competitive against many producers that have a stable supply of quality biomass with predictable costs, sourced from within their organisation. **Externally sourced** biomass further has typically lower homogeneity and more impurities that may require additional steps to shred, sieve, remove mineral contents and other impurities.

Future costs and availability of waste biomass for pyrolysis cannot be foreseen today and are subject to **policy changes**. When sourcing biomass externally, 1-2 year contracts allow to control prices. Longer guarantees are not common. Additional purchases can be made on the spot market when the price is low. More creative business models like exchanging biomass in return for produced biochar, or taking unprocessed waste biomass for free which would otherwise be disposed should be considered as well.

Another proven option is to source different kinds of biomass to **reduce dependency** on one kind and/or supplier. Different kinds of biomass or sizes give further the option of mixing them for obtaining the right density and structure for more streamlined automated processing.

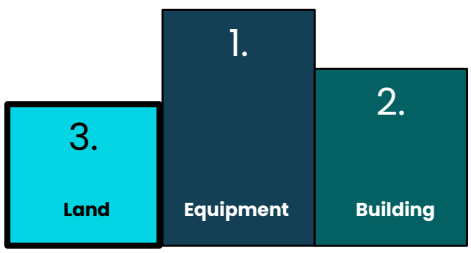


Location, location, location: What applies to the real estate is also true for biochar production

Biochar production comes along with energy production in the form of heat and preferably also power. In the ideal case your **plant is co-located** with an industrial **consumer of large amounts of heat** and optional power, or the plant is close by a heating network.

The pyrolysis equipment itself has a fairly small **footprint** and typically doesn't require more than a light **building**. Post-processing equipment though often requires more protection and space. A smaller industry-scale plant may need e.g. 400m^2 floor space on a land the size of 0.5 to 1 hectare for logistics and storage of e.g. biomass and biochar.

If you have the option to re-use an **existing building** with the needed floor area and height, this can be a key advantage as building cost as well as land cost each rank within the top three capital expenditures.



Top ranked capital expenditures

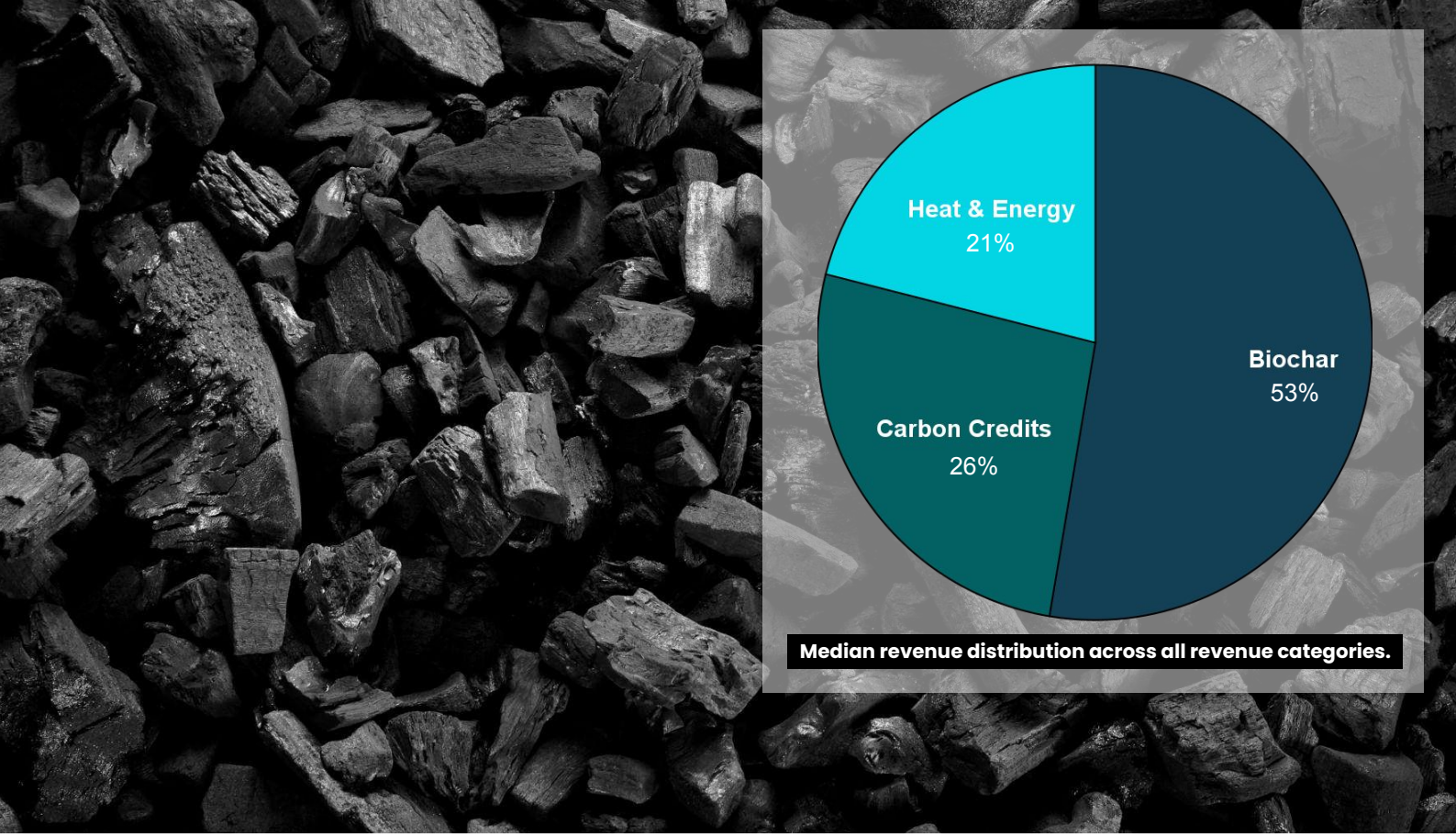
Understanding your most critical capital expenditure: **Equipment**

Equipment cost are consistently the highest capital expenditure for biochar producers, ranging from smaller industry to larger industry scale between 3 and 30 million €. The pyrolysis equipment itself plays has a significant share, as does pre- and post-processing equipment, as well as gas turbines and generators for electricity production. Equipment for electricity production alone can account for 1+ million €, but has a short return on investment and added flexibility for revenue generation.

Most biochar producers today use **off-the-shelf equipment with continuous processing**. We observe a wide array of manufacturers being used across biochar producers, but also across different applications of the same producer, to best suite the specific use case. Many producers apply a modular set-up with multiple production lines in parallel for greater flexibility and higher resilience.

Ramping up biochar production to reach the target **uptime** requires some time for fine-tuning operations, incl. feedstock drying, cleaning, shredding or pelletizing, mixing, packaging of the raw biochar, or post-processing. Externally sourced biomass with its higher variance in quality and heterogenous biomass require more robustness in processing and fine-tuning.

We suggest to have a general contractor, with **service level agreements** for the whole plant, to resolve issues quickly.



Median revenue distribution across all revenue categories.

Selling **biochar** is challenging, but possible with the right product strategy.

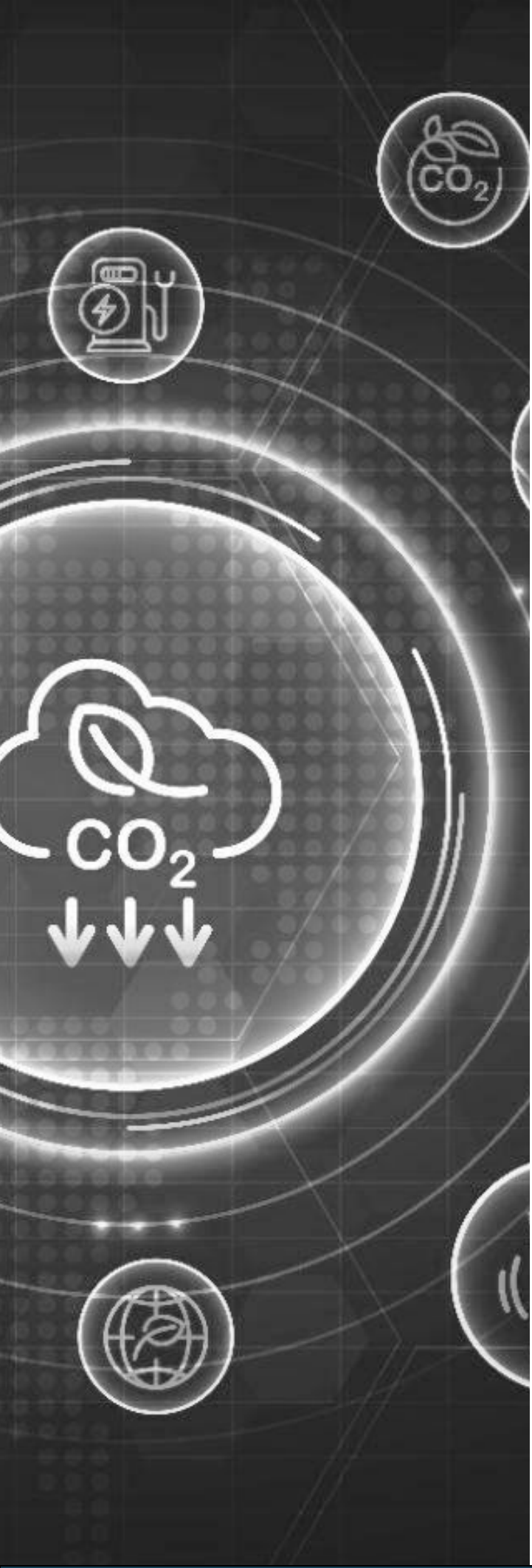
Typically around **50% of revenues** of a pyrolysis plant relate to biochar and biochar-based products. A realistic **product strategy** is therefore key:
a) **use of biochar inside** your organisation, e.g. to enhance compost, soil substrates, or concrete,
b) have **long-term partnerships** with organisations that can embed biochar into their products, or
c) **invest in product development**, marketing, and sales of final products, e.g. for agriculture applications in soil, or as feed.

To be less dependent on one product, many producers follow a **multi-product strategy**.

The main **channels** for biochar sales are direct sales to large volume buyers in various agricultural and industrial sectors. Online shops and wholesalers play a minor role today in biochar sales.

Unprocessed biochar is hard to sell, unless you can offer it for a very low price and at the same time at very high volumes.

Anticipate in your business model that the average **price for biochar** is expected to decrease over time as more producers enter the market.



Demand for **Carbon Credits** is high, but it comes with a cost.

Carbon credits account fairly consistently for about **25% of revenues** of a biochar operation. Large volumes are **sold** typically **directly** to commercial buyers or via carbon credit **marketplaces** like carbonfuture, Senken or Supercritical.

The two major **certification frameworks** in use are Puro and EBC C-sink. Automation efforts should be planned in either case to reduce the effort to generate carbon credits at scale with minimal human interaction. E.g. if you chose the EBC C-sink standard, your biochar buyer should quickly confirm to you that the biochar is applied, in order to generate the carbon credits. Alternatively if you choose the Puro methodology, you only need contractual proof that the biochar buyer will apply it in a way that ensures the bound carbon is not released again.

The future **price for a carbon credit** is hard to predict today, as it will depend on future demand triggered mainly by policy developments and supply via various carbon removal pathways.

Maximising use of excess **heat** and generated **power** are key profitability drivers.

Energy production accounts as well for about **25% of revenues** of a biochar operation.

As heat is harder to transport, the **location choice should ensure there is sufficient use for heat**, beyond use for drying of biomass. Examples include co-located factories that need process heat, or the ability to sell to a heating network. Utilization of heat may also be a requirement for certain carbon credit certifications.

Power generation is part of the great majority of industry scale biochar producers. When used within the organisation, this green energy can replace externally sourced electricity, that is otherwise purchased at higher market prices. Excess electricity can be sold to the grid for market prices as well.

Despite capital expenditures for power generation equipment being high, a lot of producers chose to build on this extra revenue stream to obtain stable electricity prices when used internally, and for more **flexibility** in revenue options for the future.

EU grants will help you finance industry scale biochar projects.

On average to produce 1.000 tonnes of biochar per year, one needs to **invest** 4 million € today.

To be able to profitably sell biochar-based products, carbon credits, heat and power, a large fraction of the capital expenditures for equipment and building needs to be subsidized. EU **grants** exist for this purpose and are used by many producers to finance 30-70% of their plant investment costs, or up to 100% of costs for individual parts.

As EU grants require significant effort to obtain and manage, a **partner** should be chosen to support in the application process.

"Transforming your biochar project into a success story"

biochar zero

Fascinated by biochar, we started in 2021 with the intention to produce it ourselves. We went through the whole process from finding a location, biomass, selecting equipment and potential buyers. In the end we realised we didn't have the needed equity to complete the project.

Since then we conducted more research, market studies and built an enormous biochar network in Europe.

Today we **work with** many **biochar project developers** and existing **producers** to share our market knowledge, experience, conduct feasibility studies, and support project planning, certification, and financing.

If you want to become a biochar producer, you are in good company! The European biochar market is growing: 54 new plants expected in 2024, policy support is on its way and the biochar ecosystem is growing.

The time is now–let's tackle climate change together at scale!

Visit our website for more resources or contact us.

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