Earthworm

# Charcoal Carbon & Forest Footprint (CCFF) Rationale & methodology

## Contents



## 1 Introduction – Why a Carbon & Forest Footprint

Charcoal is a carbon rich fuel created by heating wood in a low oxygen environment (pyrolysis).

According to the FAO[1], GHG emissions from traditional wood energy (of which 17% is charcoal) contribute to 2–7% of global anthropogenic emissions annually. **The greatest proportion (up to 80%) of GHG emissions in the charcoal value chain are due to unsustainable wood sourcing, the use of low efficiency carbonization technologies and the combustion.**

Depending on the technology used, between **4-12 tonnes of wood are used to create 1 tonne of charcoal**. This wood can sometimes be from **irresponsible logging practices** leading to deforestation in the worst cases. Better technologies demand more infrastructure but the emissions linked to this infrastructure are outweighed by the efficiency gain in production (using less wood to make more charcoal) in the lifetime of the facility.

Therefore, using the knowledge and experience from over 300 field visits to carbonisation factories, Earthworm Foundation (EF) created a tool enabling companies to calculate the estimated **Carbon & Forest Footprint** of the charcoal they produce or buy, using mainly data on wood origin and efficiency of technology..

The goal was to develop a tool which requires only a few “easy to get” inputs to give an estimate of the footprint, without needing detailed life cycle assessments or emission measurements at every step of the production, since most of the emissions are linked to wood sourcing and technology. **Through the CCF, EF**

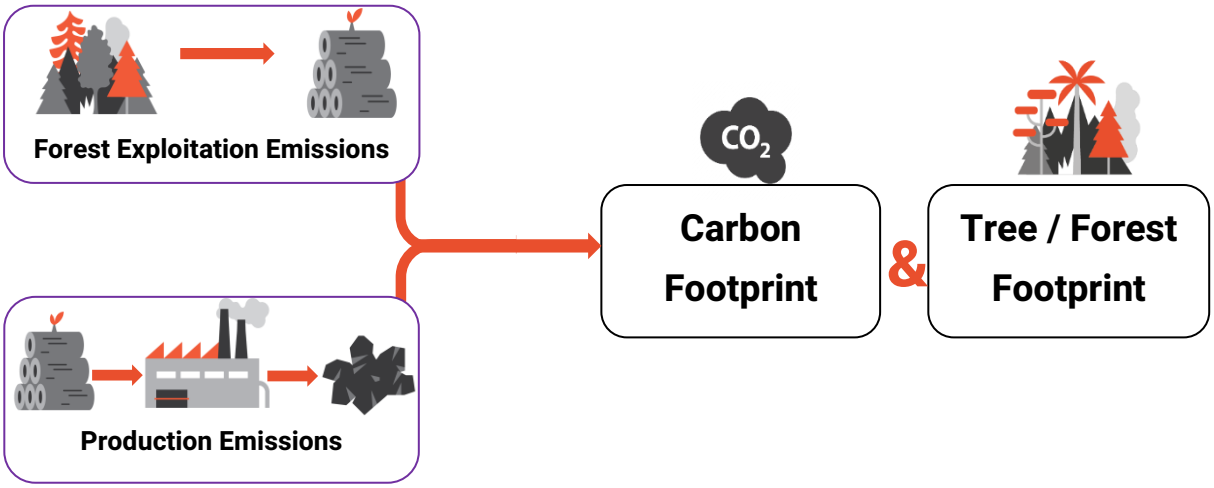
[1] FAO, The Charcoal transition, 2017

**wants to encourage all actors to limit emissions in their supply chains by exploring more responsible sourcing possibilities & efficient production technologies.**

# 2 What the CCFF Provides

The CCFF is a tool that enables companies that make or purchase charcoal to get an estimated ***Carbon Footprint*** and ***Forest Footprint*** of the charcoal

- **Carbon Footprint**: estimated metric tonnes of CO2e [2] released from forestry, production and combustion of the product per tonne of charcoal produced.
- **Forest Footprint**: estimated number of trees or forest surface area needed to create this charcoal (uses local forestry density data depending on the country and wood species). Note that the forest footprint is not displayed on the CTI website.




# 3 How we calculate the CCFF results

## 3.1 General idea

The CCFF provides these 2 KPIs based on various simple inputs of estimated forest exploitation, production and transport emissions, without requiring detailed emission measurements or life cycle assessments from charcoal producers. The tool was made with the knowledge accumulated by EF during our multiple field visits and uses producer specific data provided during field assessments for greater accuracy.

The most relevant and impactful element to the carbon footprint of charcoal is the wood harvesting. Contrarily to what some industry players might say, wood is not always a renewable resource. This depends on the difference between the time it takes to grow the tree (stocking) carbon, and the time it takes to burn the tree. It also depends on biodiversity as more biodiverse ecosystems normally stock carbon better in the soil and vegetation[3].

[2] CO2 equivalent is a unit of measurement that is used to standardize the climate effects of various greenhouse gases as different gases have different global warming potentials

[3] Anand M Osuri et al 2020 Environ. Res. Lett. 15 034011 *Greater stability of carbon capture in species-rich natural forests compared to species-poor plantations*

Deforestation and forest degradation (due to unsustainable forestry and logging of old growth forests) are together thought to be the biggest CO2 emitters in the world. **The importance of the origin of the wood used to make charcoal as well as the risks to forest degradation in the country of origin** (due to illegal or unsustainable logging practices) **are therefore the most important factors in the CCFF**. EF has extensive knowledge on forestry practices in different countries and risks to deforestation, illegal logging and degradation and a high-risk country of origin (where deforestation is rampant) will return a high CCFF value, while areas with better forest management practices will have lower CCFF scores as the carbon impact of forestry is small and recovered by the ecosystem.

Another important factor is the type of wood used because using sawmill residues (essentially using another industry's waste) is less impactful than using roundwood logs straight from the forest.

The second most important factor after the origin and type of wood is the production process. Depending on the technology used, between **4-12 tonnes of wood are used to create 1 tonne of charcoal.** This means that some technologies are up to 3 times more efficient than others, having a big impact on emissions. Efficient technologies reinject pyrolysis gazes in the combustion chambers to limit GHG emissions from charcoal production, whereas basic charcoal production technologies (such as earth-mounds or barrels) are less efficient, therefore requiring more wood and emitting more pollutants and GHG for the same result. Some very well-advanced technologies can even produce electricity by using the excess energy from the process.

## 3.2 Scope 1,2 and 3 emissions

The tool focuses on scope 1 emissions which is the production process, and the most impactful scope 3 emissions which are the impacts on forests and the combustion (see details in Table 1 and Annex 1). Scope 2 emissions are less important and also much harder to calculate and not included in the present version of the tool to avoid complexity.

*Table 1: Scope 1,2 and 3 emissions taken into account*

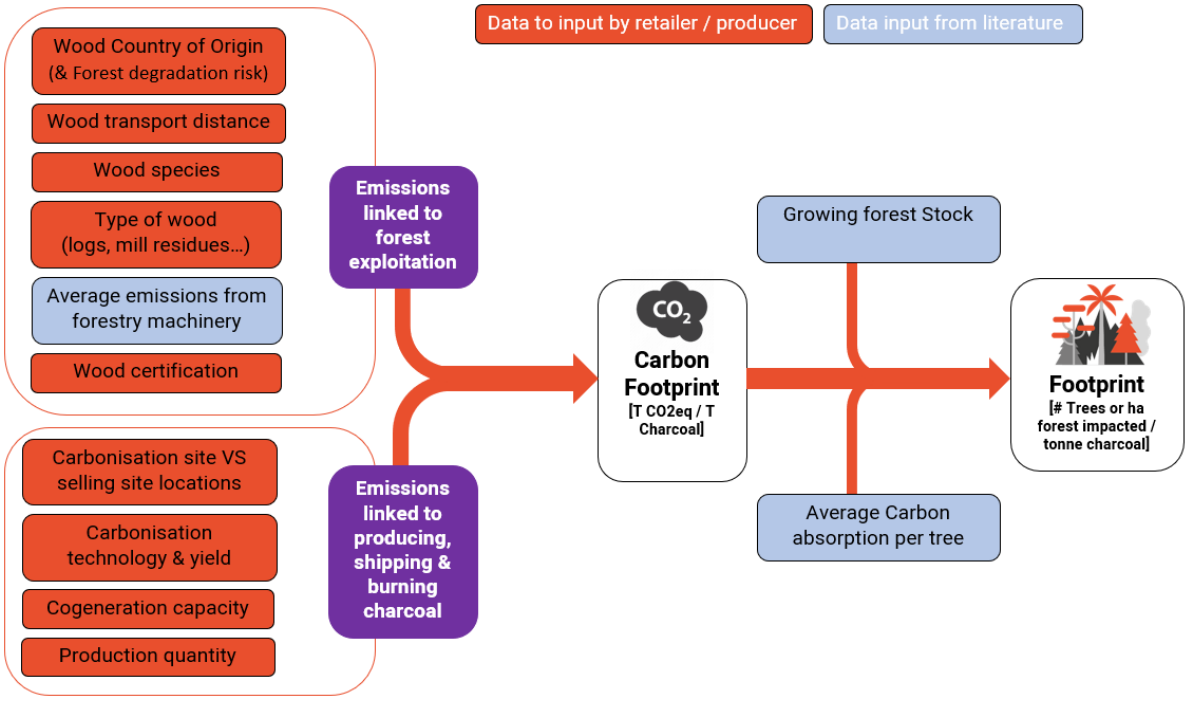
| | **Scope 1: direct emissions** | **Scope 2: indirect emissions – owned** | **Scope 3: indirect emissions – not owned** |
|---|---|---|---|
| **Included** | Emissions of the carbonisation of wood to charcoal (averages used by knowing the technology and yield) | Emissions from charcoal transport if not produced in same country | Emissions from wood transport & forestry machines (averages from industry)<br>Impact on forests estimated using 3 factors based on: risk due to detrimental logging practices, if wood is certified or not, type of wood used<br>Emissions from burning of charcoal |
| **Not Included** | Emissions from machinery used in the factory (vehicles, wood cutting process…) | Emissions from heating / cooling the offices as well as electricity<br>Emissions from the construction of the charcoal production site | Emissions related to the production of used materials such as charcoal bag packaging<br>Emissions from transport of personnel |

**By applying the scope above, the methodology focuses on the greatest proportion (up to 80%) of GHG emissions in the charcoal value chain.**

## 3.3 Inputs for the CCFF

Without being able to measure emissions at all production sites, **the main data that the CCFF tool uses to estimate the carbon and forest footprints are**:

- **Volume** (how much charcoal comes from which production site)
- **wood species (**used at each production site and proportions per species)
- **Carbonisation technology and yield** per site (m3 wood used / tonne of charcoal produced)
- **Type of wood** (logs; small diameter cuttings; sawmill residues …)
- **Country of Origin of the wood** (from this, EF calculates the Forest degradation risks associated to the origin of the wood → the higher the risk of unsustainable forestry practices or illegal logging in the country, the higher the footprint due to increased impact on the forestry ecosystem.)
- **Certification of the wood** (It is assumed that FSC or PEFC certified wood is from better managed forests than not certified)
- **Emissions data from literature** (for example for wood and charcoal transport; forestry machinery - depending on the country of harvest).
- **Cogeneration** (creation of excess electricity at the production site that is sold to neighbouring buildings)
- **Distance from forest to production site and transport distance of the charcoal** (if imported)




See annex 1 for more details on inputs.

Earthworm

# 4 Scoring

The results of our CCFF score are displayed in a simple A to E grade as we do for our other evaluations (A presenting the lightest footprints, E presenting the heaviest footprints).

| Score | Level of Footprint | kgCo2e / Kg charcoal |
|---|---|---|
| A | Low carbon footprint | 0.1 – 1 |
| B | Low – medium carbon footprint | 1 – 1.5 |
| C | Medium carbon footprint | 1.5 – 2.5 |
| D | Medium to high carbon footprint | 2.5 - 4 |
| E | High carbon footprint | > 4 |

To improve a score from E→A, charcoal needs to be produced locally, with efficient technology from wood harvested responsibly or from wood waste from sawmills. **Note that better data leads to higher scores as otherwise averages are used which often decrease the score.**

# 5 Limitations to the Methodology

**The footprints calculated are indications, not exact measurements!**

These are there to help the user of the tool assess the level of impact of the charcoal on the forest and provide them with an indicative number (footprint) to use for insetting or offsetting these emissions. Many assumptions and averages are used to make this tool simple and useable in almost all contexts without precise emissions data.

- The emissions and footprint calculated are meant to reflect the **main impacts** which are linked to the **forest**. All other emissions are out of scope and considered less impactful over the lifetime of the charcoal production.
- 3 major influencers of the footprints are: Wood assortment type, Country of harvest degradation risk factor and Certification reduction factor. These are innovative ways to include forestry impacts into the calculation (which other methods don't do) but are also qualitative rather than quantitative.
- Some assumptions are used with averages to avoid asking for data that is too demanding to obtain from the producer (for example, baseline emissions are used for harvesting the wood in the forest for countries where this process is mechanised)
- Data gathered from production sites (especially the yield) are generally collected during field visits. However, If EF has not visited a site, average values corresponding for the technology are used.

**The results of the CCFF have been crosschecked with other life cycle analyses (LCA) available provided by partners. The results of the CCFF coincided well at different ranges with the results of these LCAs therefore, giving credibility to the CCFF.**

# 6 Footprint reduction possibilities

The CCFF provides us with **quantifiable values** that can be reduced by applying some key improvements to the supply chain or to technologies used. For example:

- Improve technology or yield through investments in the production companies. e.g., by investing in current technology (better insulation, reinjection of pyrolysis gazes, etc) or by investing in a new technology if needed
- Obtain wood only from low-risk sources / work with wood providers on sustainable forestry practices
- Use only waste-wood (such as sawmill residues, agricultural residues or leftovers from veneer) to make charcoal
- If wood is from forestry operations, only use small diameter firewood class.

EF encourages all actors to limit / reduce their footprint and to participate in programs that protect nature and people. In addition, EF promotes multiple field projects working for people and nature and can assist companies looking to reduce their carbon / environmental / biodiversity or social impact.

# 7 Annex 1: details of inputs needed

| Category | Required inputs |
|---|---|
| Forestry operations and forest carbon | • Country of harvest<br>• Average distance from forest to production site<br>• Certification of Wood (FSC 100%) |
| Charcoal Production | • Producer & production Site name and location<br>• Wood assortment type (whole logs / firewood class / sawmill residues / agricultural waste)<br>• Wood species and proportions of species used<br>• Yield = tonne of wood used (Including wood to start carbonisation process) per tonne of charcoal produced (including fines and dust)<br>• Cogeneration (amount of electricity generated using gases from pyrolysis)<br>• Production technology |
| Charcoal Product and brand | • Product / Brand name<br>• Product Bag weight<br>• Product producing site names (one product can contain charcoal from multiple production sites – listed individually in the section above)<br>• Yearly production of product in tonnes<br>• Brand company location |
| Retailer | • Retailer company name<br>• Amount of charcoal product planned for purchase for coming year |

| External inputs (averages and values from literature) |
|---|
| • Emissions from harvesting machinery and wood transport (use of average for countries with mechanised forestry)<br>• Country of harvest degradation risk factor: based on EF's country risk assessments. Provides a factor that is applied to emissions based on types of forestry operations in the country*<br>• Certification reduction factor (considers certified wood to have a lower footprint (if from a low-corruption country of harvest)<br>• Growing forest Stock (from FAO Forest Resource Assessment)<br>• Average Carbon sequestration per tree over 30 years growing time<br>• Average wood densities for dry wood<br>• Producer transport Footprint from production site to selling country (using an emission calculator Ecotransit) |

# 8 Annex 2: Example of results

Simplified Example of footprint for Charcoal originating from 3 sites: 1 site in Ukraine, 1 in France and 1 in Nigeria (with limited information on sustainability of harvesting practices). The purple cells contain data provided by the producer or retailer.

| | | | | | | | | | Carbon Footprint | Forest Footprint |
|---|---|---|---|---|---|---|---|---|---|---|
| **Producer** | **Country** | **Country of harvest forest degradation risk[4]** | **Technology** | **Wood assortment** | **Wood species** | **Is wood certified FSC?** | **Does site produce electricity (cogeneration)** | **Yield [m3 wood / T charcoal] [5]** | **T CO2e / T charcoal - Rough Estimation of the impact of the charcoal** | **Equivalent in forest area [ha] impact of 1 tonne of charcoal** |
| Example Ukraine | Ukraine | Medium-High | Drum Kiln | Firewood | 100% Oak | No | No | 7 | **2.5** | **0.012** |
| Example France | France | Low | Retort | Firewood | 100% beech | Yes | Yes | 4.8 | **0.6** | **0.002** |
| Example Nigeria | Nigeria | High | Earth mound | Logs | 100% Acacia | no | no | 10 | **9.7** | **0.12** |

**Note** that some aspects taken into account in the calculations do not appear in the table above (such as the distance between the 3 sites and the country where charcoal is sold as well as forestry operations emissions and wood transport to name a few).

[4] Calculated using EF's risk assessment per country / region of harvest using EF's field knowledge

[5] Includes wood burnt in oven as well as charcoal fines and dust