

Technical and environmental performance of the Green Mad Retort charcoal-making kiln in Madagascar



CONTEXT



90% rural and urban
household dépend on wood
energy for domestic cooking



This means a turnover of

125 mio €





VALUE CHAIN DEVELOPMENT THROUGH INNOVATION



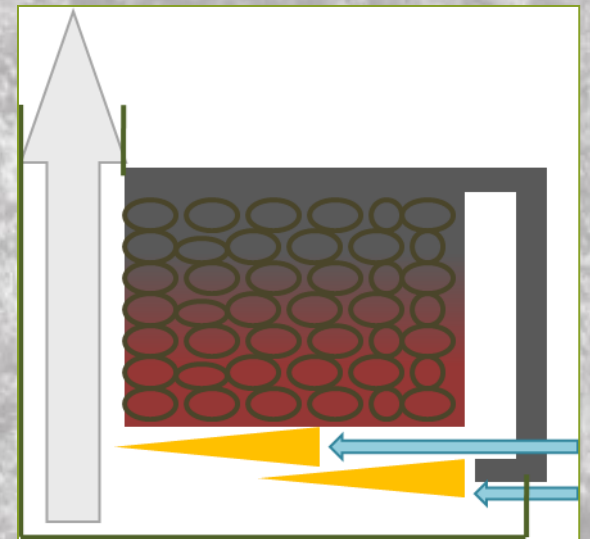
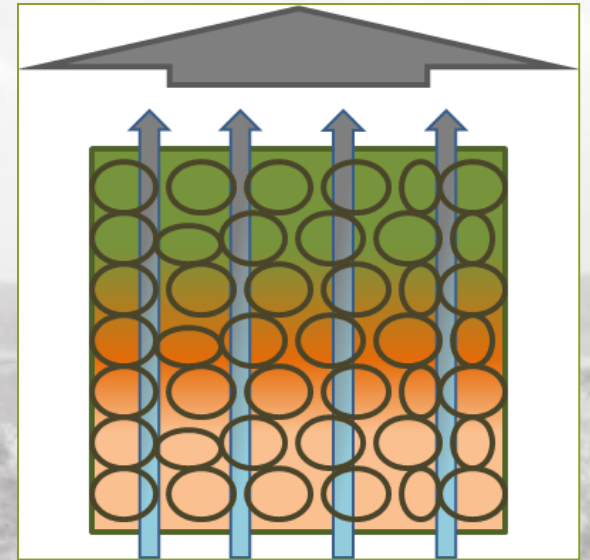
CHARCOAL PRODUCTION PROCESSES

Carbonisation techniques are grouped into 2 main principles:

- *Partly combusted load processes*
The energy required for carbonisation comes from the combustion of a share of the load
- *Retort kilns*
The pyrolysis gases combustion is controlled in order to supply the process with energy

To assess the quality of a charcoal production

- *Carbonisation mass yield*
- *The quality of the charcoal produced*
- *Carbonisation emissions*

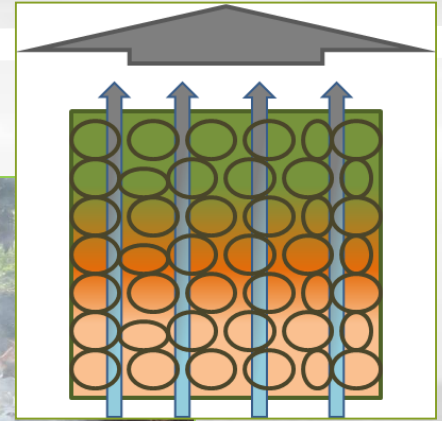


CHARCOAL PRODUCTION PROCESSES

Partly combusted load processes are mainly small-scale processes

- *Include a wide range of charring techniques*
 - *Traditional & improved earth mound kilns*
 - *Brick kilns*
 - *Metal kilns*

- *Advantages:*
 - *Low or no investment*
 - *Low technology*
 - *Local materials*
- *Disadvantages*
 - *Low & variable yields (12 to 30%)*
 - *High pollution*
 - *Demanding on operator skills*

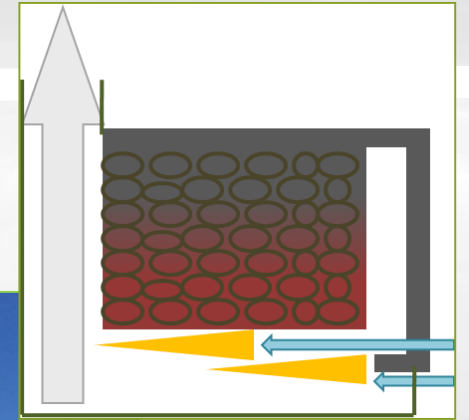


CHARCOAL PRODUCTION PROCESSES

Retort kilns are mainly industrial processes

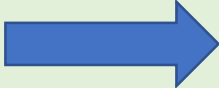
*Some technologies are commercially available
MOVI, Carbonex, Bruni/Cirad/Sidenergie,...*

- *Advantages:*
 - *Consistent & high-quality production*
 - *No CH₄ emissions*
 - *High yields: 35% & more*
- *Disadvantages*
 - *High investment*
 - *Need for handling equipment*
 - *High technology*



EMISSIONS FROM CHARCOAL PRODUCTION

The fumes released from the Partly combusted load processes contain

*CO,
HAP,
Fine particles* }  *Human health*

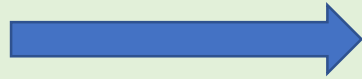
*CH₄,
CO₂* }  *Greenhouse gases*



In retort kilns, the combustion of pyrolysis gases removes CH₄ and other polluting compounds.

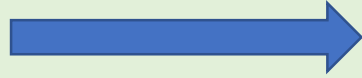
MAIN KILNS IN USE IN MADAGASCAR

Traditional kilns



Yield 12 - 15 %

Improved traditional kilns



Yield 22 - 28 %

Both techniques emit methane & polluting compounds

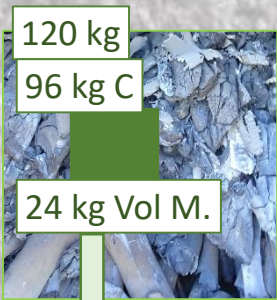
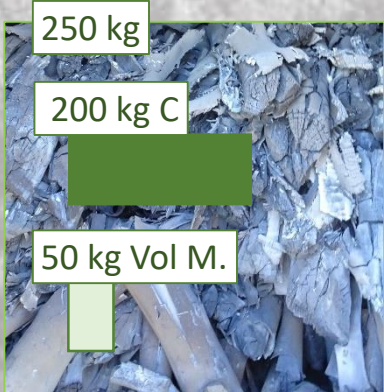
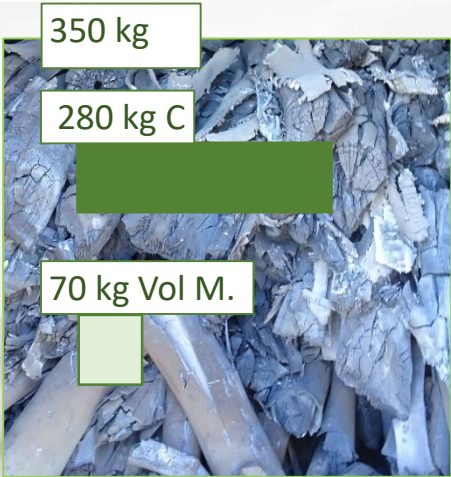
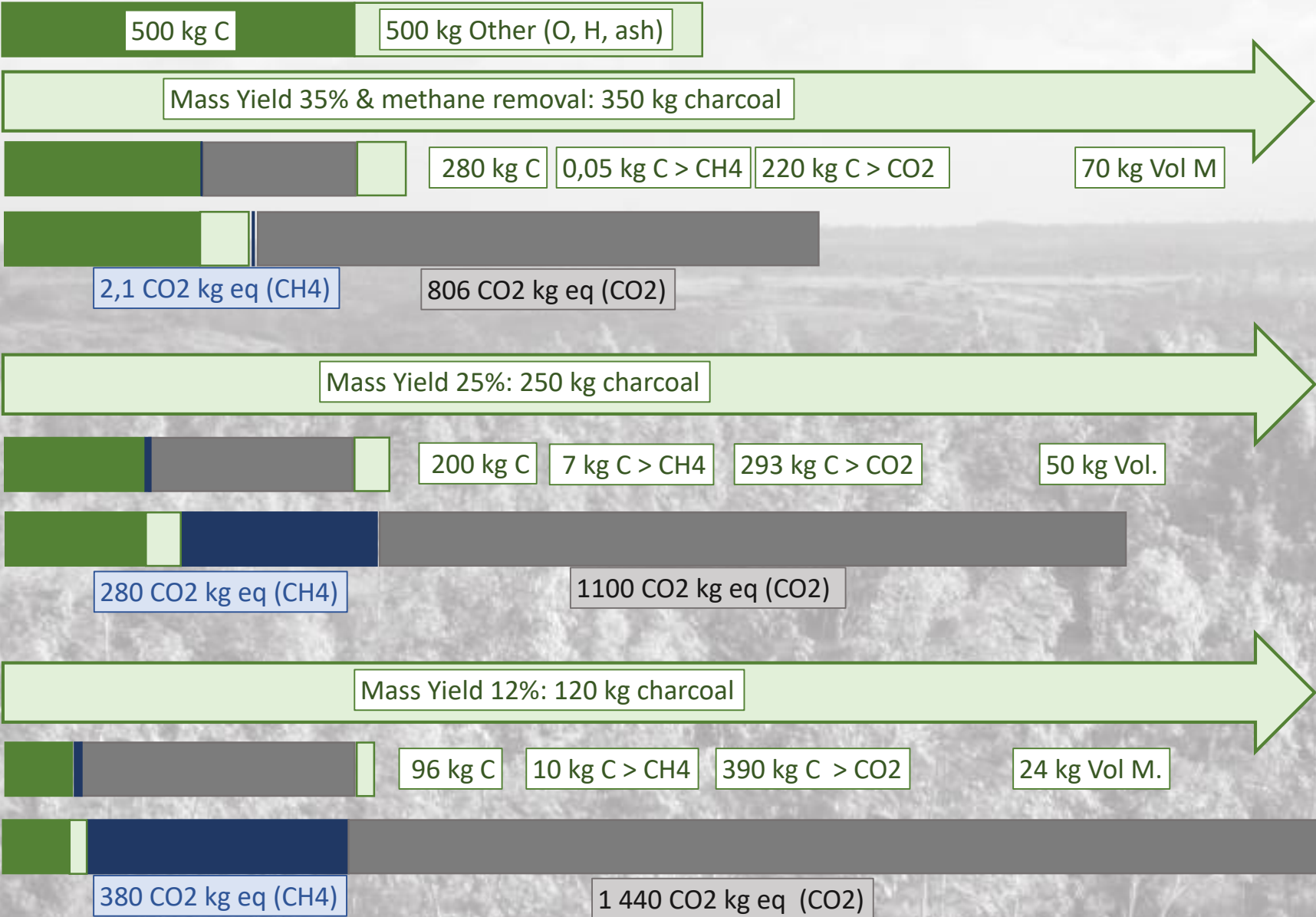


These kilns mainly differ in

- *the training of charcoal makers*
- *good charcoal production practices*
- *some simple technical modifications*

ENVIRONMENTAL IMPACT OF CHARCOAL PRODUCTION

1 000 kg Wood



CHARCOAL PRODUCTION YIELD & EMISSIONS

1 tonne charcoal production

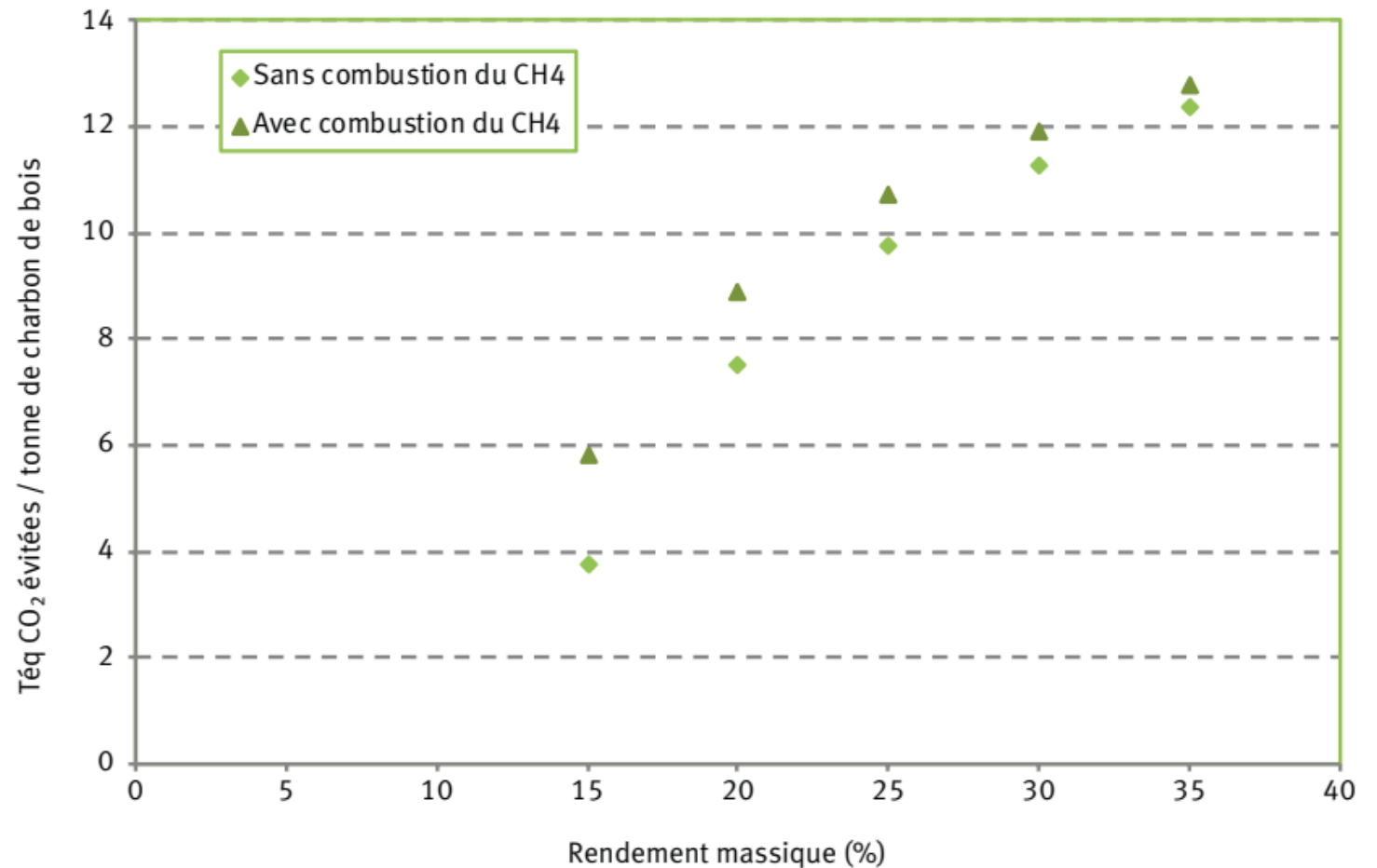
@ 12% Yield release 15,2 CO₂ Teq

@ 25% Yield release 5,4 CO₂ Teq

@ 35% Yield release 5,4 CO₂ Teq

*From an environmental perspective
improving carbonisation efficiency
and eliminating methane emissions
are of key importance*

*Avoided CO₂Teq emissions by substituting one tonne charcoal
produced at a yield of 12% with one tonne of charcoal produced
at a higher yield*



GMDR CHARCOAL PRODUCTION KILN

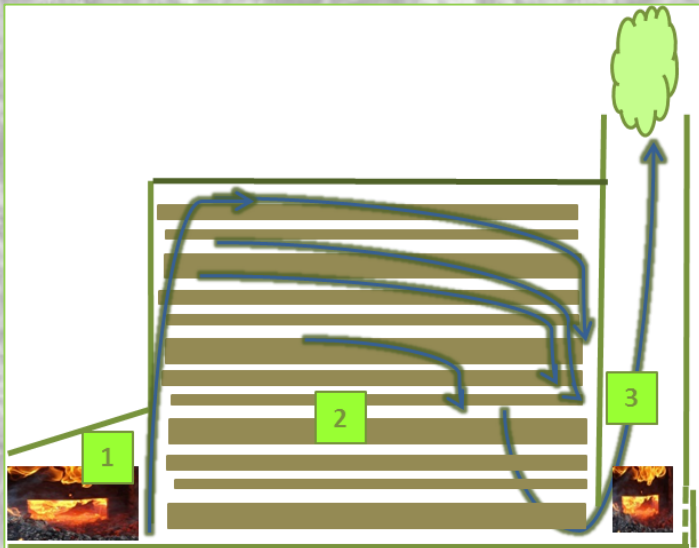


Brick & reinforced concrete kiln

No metal (reduced wear and tear costs)

Divided in 3 parts:

- *Combustion chamber*
- *Carbonization chamber*
- *Smoke cleaning system and chimney*



FIELD TRIALS

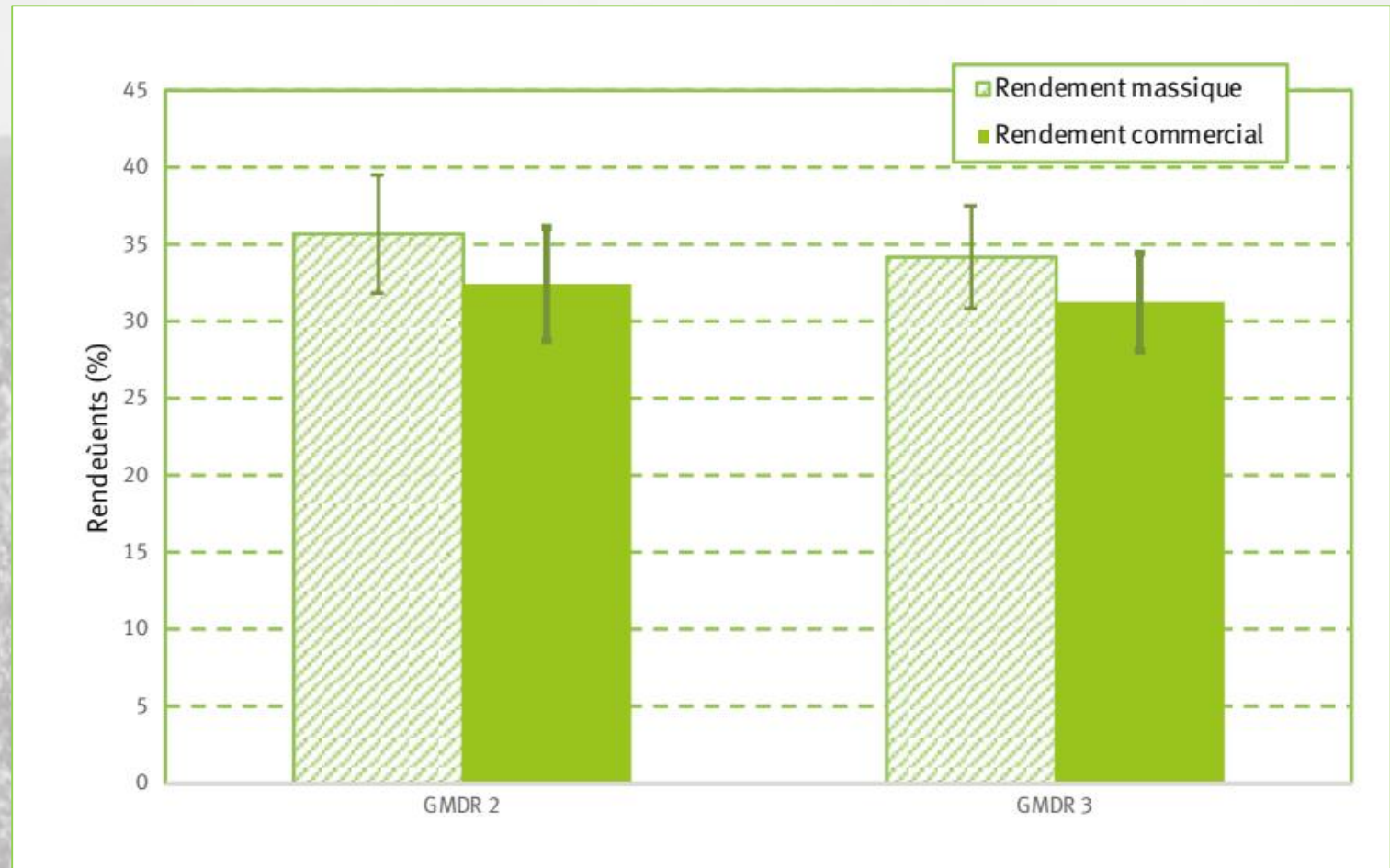
- *Monitoring of 45 carbonisation cycles of Eucalyptus wood from plantations*
 - *23 cycles without flue gas cleaning (GMDR 2)*
 - *25 cycles with flue gas cleaning (GMDR3)*
- *The following information were recorded*
 - *Mass of incoming wood (load)*
 - *Wood moisture content*
 - *Mass of charcoal produced*
- *For half of these tests*
 - *CH₄ concentration*
 - *Kiln Temperature*
 - *gas flow*



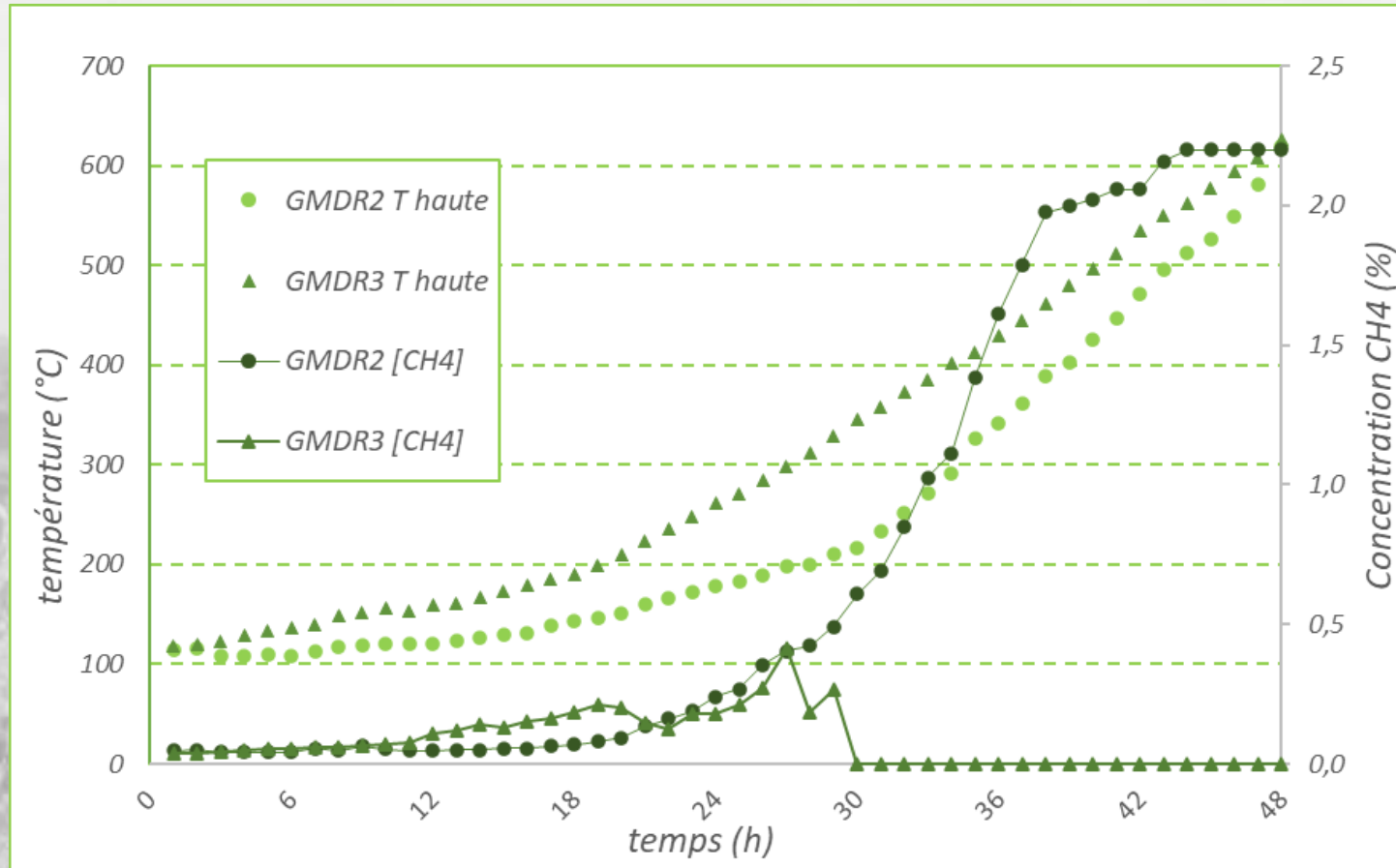
THE MASS YIELD OF A GMDR

The yields are

- *among the highest charcoal production yields*
- *very stable*
- *not influenced by the gas cleaning*



EMISSIONS FROM A GMDR



Thanks to flue gas cleaning, GMDR emits only 4 kg of methane/ton of charcoal



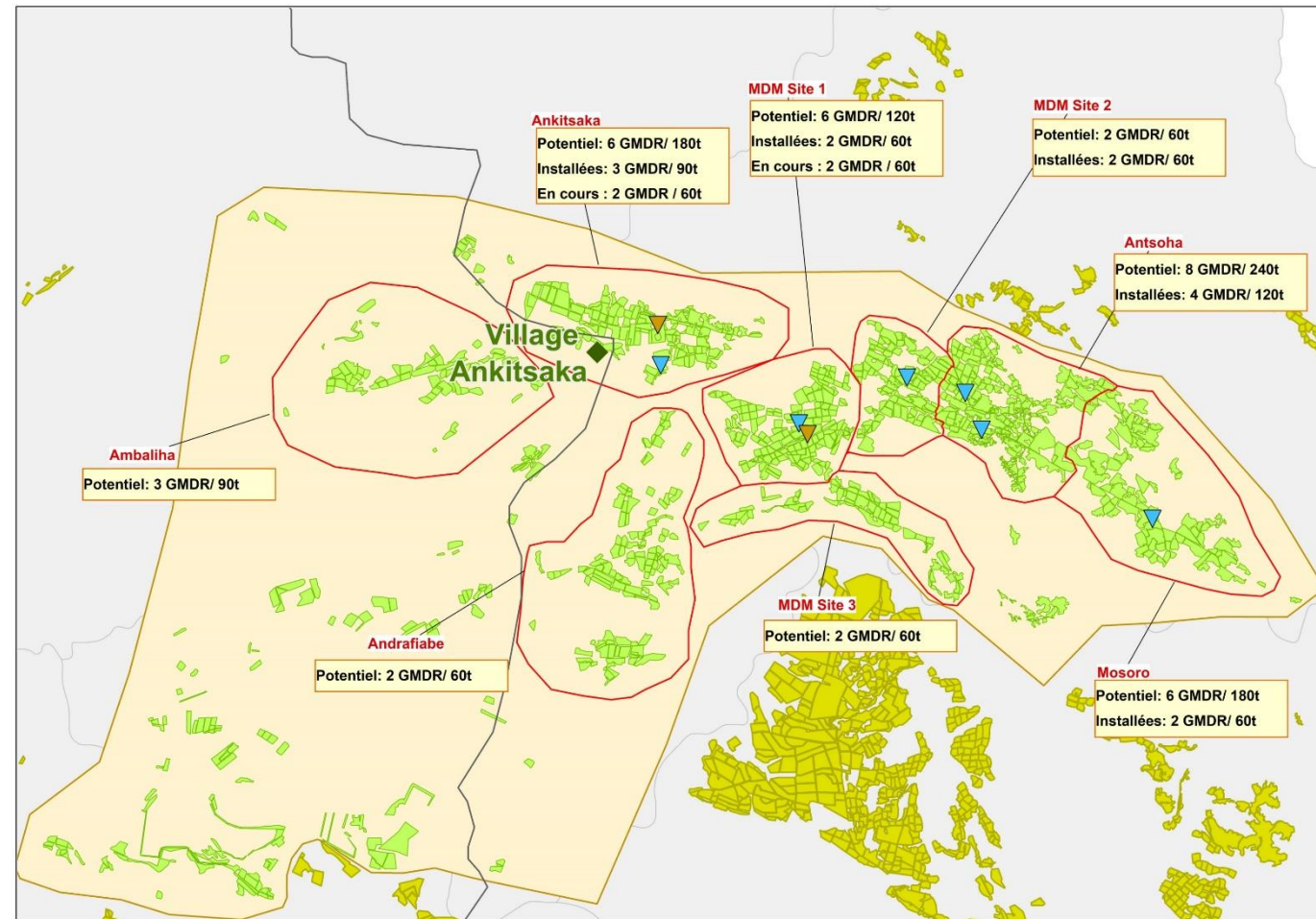
35% efficiency + CH4 remove avoids the emission of 13 CO2Teq /Tonne of charcoal

KEY ELEMENTS

- *GMDR is a very high yield charcoal production technique*
- *Low technology*
- *Long life span (more then 10 years)*
- *Reduces the time needed for charcoal makers by 3*
- *High and stable yields (35%)*
- *CH₄ cleaning*
- *By replacing one tonne of traditional kiln charcoal, one tonne of GMDR charcoal avoids 13 CO₂Teq*
- *Compared to traditional kilns, a GMDR avoids the emission of 400 CO₂Teq /year*
- *Low cost (construction 5000 €, support 5000€)*

PERSPECTIVES

- *The implementation is done in consultation with the beneficiaries according to the possibilities of their plantation (harvesting plans)*
- *The set up an efficient management structure is needed*
- *An appropriate and sufficient training component is to be provided*
- *In Madagascar, 54 GMDRs are under construction*
- *This represents 21,000 CO₂ Teq avoided per year*
- *The 7000 ha of the DIANA Region could be exploited with 270 GMDRs*
- *The potential for using GMDRs is significant in Madagascar, as it is in sub-Saharan Africa*



MERCI
DANKE
THANK YOU



MORE INFORMATION?

Temmerman M., Andrianirina R., Richter F., 2019. Performances techniques et environnementales du four de carbonisation *Green Mad Retort* à Madagascar. Bois et Forêts des Tropiques, 340 : 43-55.

Doi : <https://doi.org/10.19182/bft2019.340.a31700>

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