Blue Mangrove Fund
operated by FRIENDSHIP

Introduction:

These assumptions are based on numbers collected in January 2021, some will change due to the market, change of budgets, new scientific estimates. Assumptions will be revised annually. These assumptions are audited by the ULB the department of Systems Ecology and Resource Management Research Unit.

Summary:

ASSUMPTION 1:
The average CO2 emissions per capita in Belgium is: 9 tons of CO2/capita/year.

ASSUMPTION 2:
CO2 absorption capacity of mangrove plantation in Bangladesh: 24 t CO2/ha/year.

ASSUMPTION 3:
Absorption capacity of the mangroves at 24t CO2/ha/year will last for 20 years

ASSUMPTION 4:
Market value as of December 31st 2020: 25 €/t CO2e

ASSUMPTION 5:
Friendship budget per Ha = 10,000 €/ha.

ASSUMPTION 6:
Friendship full involvement for 5 years with guarantee of sustainability for 20 years

As a result:

- **Cost of CO2e offset by Friendship = 20.83 €/ton**
- **The necessary donation to offset one person CO2e is: = 3,750 €/person**
- **At today's market price, the CO2e monetary value to offset one person CO2e per year is: 225 €/year = a return of 6%**

-1- Introduction: Some vocabulary: CO2, C and CO2e[1]

A greenhouse gas (or GHG for short) is any gas in the atmosphere which absorbs and re-emits heat, and thereby keeps the planet's atmosphere warmer than it otherwise would be. The main GHGs in the Earth's atmosphere are water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone.

Carbon dioxide equivalent or "CO_2e" is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO_2e signifies the amount of CO_2 which would have the equivalent global warming impact.

Green House Gases	Global Waring Potential (GWP)
1. Carbon dioxide (CO_2)	1
2. Methane (CH_4)	25
3. Nitrous oxide(N_2O)	298
4. Hydrofluorocarbons (HFCs)	124 – 14,800
5. Perfluorocarbons (PFCs)	7,390 – 12,200
6. Sulfur hexafluoride (SF_6)	22,800
7. Nitrogen trifluoride (NF_3)	17,200

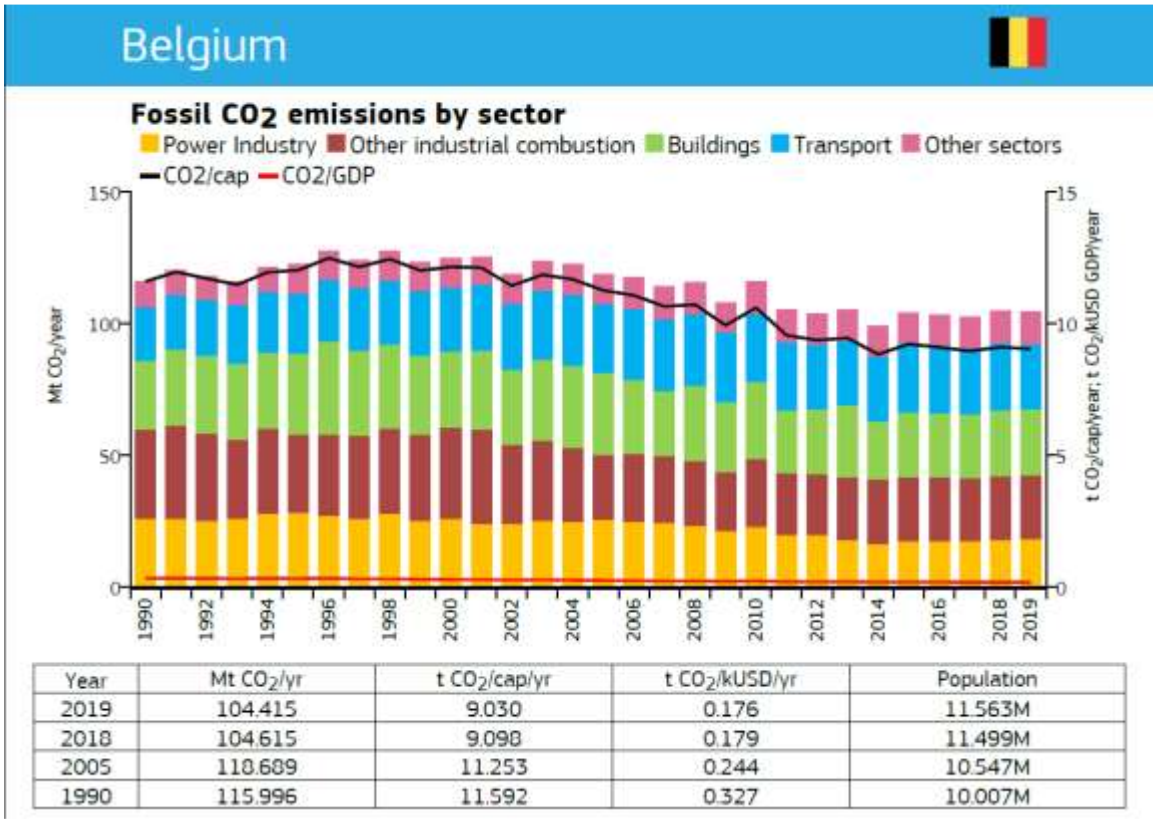
A quantity of GHG can be expressed as CO_2e by multiplying the amount of the GHG by its GWP. E.g. if 1kg of methane is emitted, this can be expressed as 25kg of CO_2e (1kg CH_4 * 25 = 25kg CO_2e).

The term "carbon" or C can be confusing as it is used as a shorthand expression to refer to either just CO_2 or to greenhouse gases in general (although not all GHGs contain carbon!). C is the confusing term used for CO_2eq in tons used to define the market price.

[1] Source: Brander, M., *Greenhouse Gases, CO2, CO2e, and Carbon: What Do All These Terms Mean?*, Ecometrica, August 2012.

-2- CO2 emissions per capita

According to the World Bank[2], emissions in Belgium were 8.55 t CO2/capita in 2016.
According to climat.be[3], it is 10.17 t CO2/capita/year.
According to the European Commission[4], 9 t CO2/capita/year (see graph below).



Year	Mt CO_2/yr	t CO_2/cap/yr	t CO_2/kUSD/yr	Population
2019	104.415	9.030	0.176	11.563M
2018	104.615	9.098	0.179	11.499M
2005	118.689	11.253	0.244	10.547M
1990	115.996	11.592	0.327	10.007M

ASSUMPTION 1:
Average CO2 emissions per capita in Belgium*: *9 tons of CO2/capita/year.

To be noted that it is an average, hence considering that every Belgian emits the same amount, whether it is a baby or an adult. In reality, there are great disparities from one person to another, especially in relation to the income[5]. The CO2 emissions generally increase with the income level. Indeed, as CO2 is emitted by burning fossil fuels, emissions per capita very much depend on the usage of fossil fuels (direct or indirect) and on personal behavior such

[2] Source:https://donnees.banquemondiale.org/indicator/EN.ATM.CO2E.PC?locations=BE
[3] Source:https://climat.be/en-belgique/climat-et-emissions/emissions-des-gaz-a-effet-de-serre/historique
[4] Source: Fossil CO2 emissions of all world countries, Report 2020, Joint Research Center (JSC SCIENCE FOR POLICY REPORT), European Commission, 2020. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/fossil-co2-emissions-all-world-countries-2020-report
[5] Source: https://www.oxfam.org/fr/communiques-presse/dans-lue-seuls-les-plus-pauvres-reduisent-leurs-emissions-celles-ci-augmentent?fbclid=IwAR0TxolrXjUsdoSu48ucECawHqWu-SZvem9ena8hBJXbmK8a9gOQPkKiFbY

as heating and travels. For example, a return trip from Brussels to New York in economy class is around 2 t CO2/pers.

-3- Mangrove CO2 absorption capacity

ASSUMPTION 2:
CO2 absorption capacity of mangrove plantation: 24 t CO2/ha/year.

We estimate that each hectare of mangrove plantation will absorb every year in tree mass and soil biomass an average of 23.76 tons of CO2 during the growing phase, i.e. during 20 years.

ASSUMPTION 3:
Absorption capacity of the mangroves at 24t/ha/year will last for 20 years

We also assume that the planted forest will remain (i.e. not cut nor burned) during at least 20 years.

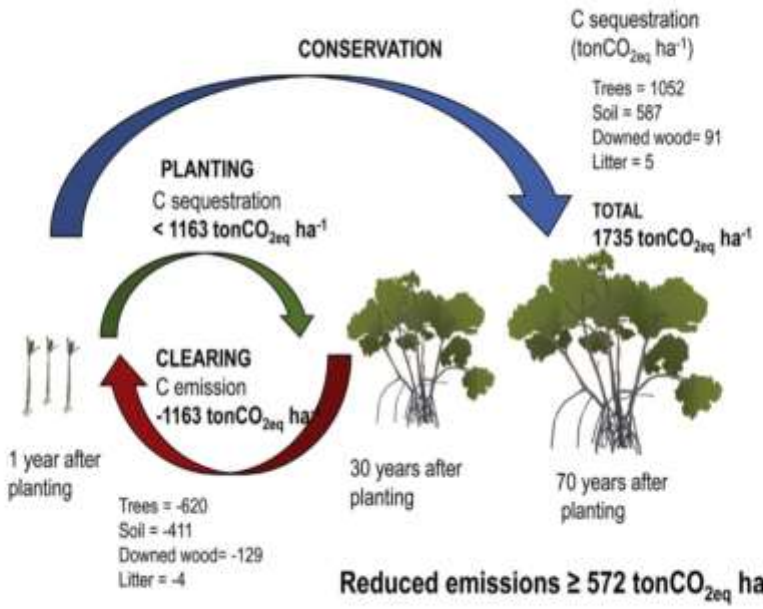


Fig. 5. Conceptual diagram of avoided emissions resulting from changes in land use practices from clear cutting-planting mangroves to conservation in Matang Mangrove Forest Reserve, Peninsular Malaysia.

Source: Adame M.F., Zakaria R.M., Fry B., Chong V.C., Then Y.H.A., Brown C.J., Lee S.Y., *Loss and recovery of carbon and nitrogen after mangrove clearing*, Ocean and Coastal Management 161 (2018) 117–126

-4- Calculation: surface needed to offset one person carbon footprint

Formula:
CO2e emissions per person / CO2e absorption per hectare of a mangrove plantation
= ***Surface required per person: 0,375 ha***

To offset the 9 t CO2 of yearly emissions of a Belgian citizen, a surface of 0.375 hectares of mangroves forest is needed to absorb an equivalent amount of CO2 from the atmosphere.

-5- Carbon market value

CO2e tons are traded on some exchanges[6]. The price is expressed as a value per ton of carbon dioxide equivalent (tCO2e)[7]. On the Bloomberg index chart the value of 1 ton was on December 31st 2020[8] as follows:

[6] Source: https://www.bloomberg.com/news/articles/2021-01-19/europe-carbon-market-emissions-permits-set-price-records-in-2021
[7] Source: The World Bank: https://carbonpricingdashboard.worldbank.org/what-carbon-pricing
[8] Source: https://markets.businessinsider.com/commodities/co2-european-emission-allowances

ASSUMPTION 4:
Market value as of December 31st 2020: 25 €/t CO2e

-6- Cost for Friendship to plant and preserve for 5 years 1 ha of mangrove

The budget for one hectare of mangrove plantation in Bangladesh has been calculated for a total surface of 50 ha. It includes land negotiation, nursery, fencing, planting, maintaining. In addition, it requires awareness raising, training and creating a sustainable income stream for the local population and keeping contact for protection of the area with local authorities.

ASSUMPTION 5:
Friendship budget per ha = 10,000 €/ha.

ASSUMPTION 6:
Friendship full involvement for 5 years with guarantee of sustainability for 20 years.

Cost breakdown of plantation and all related activities:

Project Implementation Management	19.40%
Project Running Costs & Procurement	6.41%
Nursery and Plantation	11.73%
Planted Mangrove Management	29.08%
Capacity building/ Revenue generation program	14.33%
Advocacy / Awareness	2.43%
Friendship overheads (all in Bangladesh)	15.30%
TOTAL	**100.00%**

Budget breakdown over 5 years:

Year 1	18.72%
Year 2	23.97%
Year 3	21.55%
Year 4	22.44%
Year 5	13.32%
TOTAL	**100.00%**

-7- Calculations: Donation returns.

The Friendship price to offset one ton of CO2e for a plantation lasting 20 years is:

- ***Cost of CO2e offset by Friendship = 20.83 €/ton***

Formula: Friendship budget/ha / tons stored for 20 years on 1 ha required
*= 10,000€ / (24 tCO2/ha * 20 years) = 20.83 € /Ton*

- ***The necessary donation to offset one person CO2e is: 3,750.00 €***

*Formula: Budget per ha * surface required = 10,000€ * 0.375ha/pers = 3,750.00 €*

- ***The value of a similar offsetting at CO2e market price is: 4,500.00 €***

Formula: 9 tons CO2e (personal emissions per year) x 25 € (market value) x 20 years

- **At today's market price, the return of the investment is: 6%**

Formula: 9 tons CO2e (personal emissions per year) x 25 € (market value) = 225€
225€ / 3,750€ (amount of investment) = 6% per year during 20 years