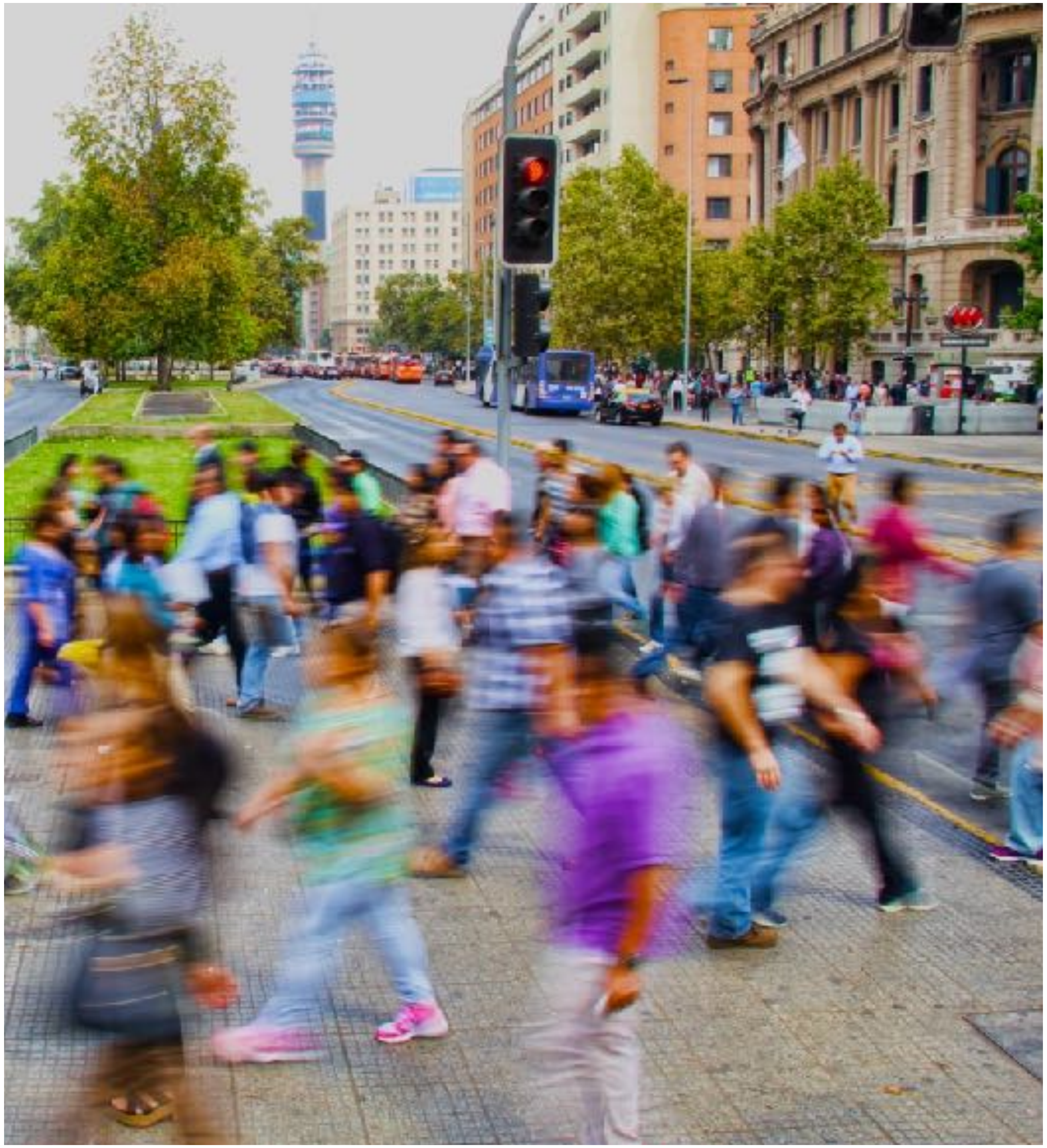
The Quambio model

Our methodology, briefly explained.



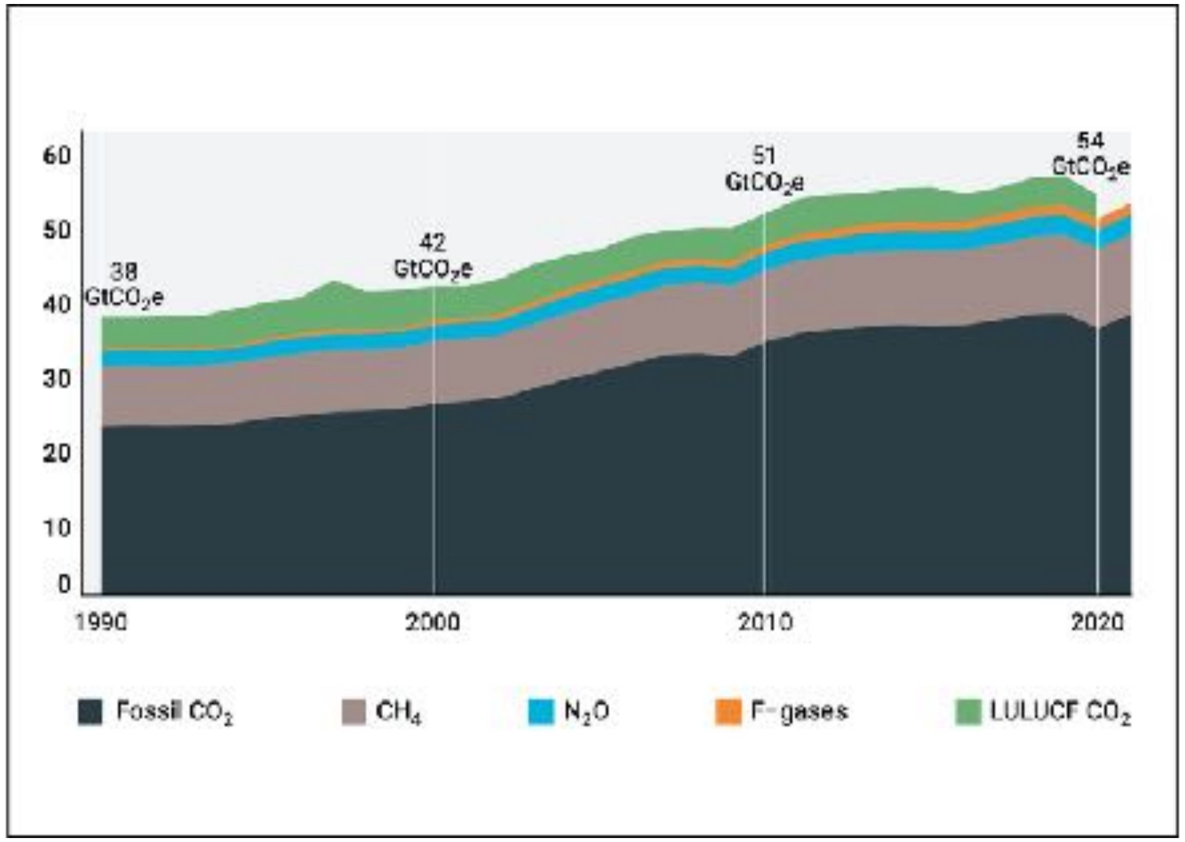
The problem

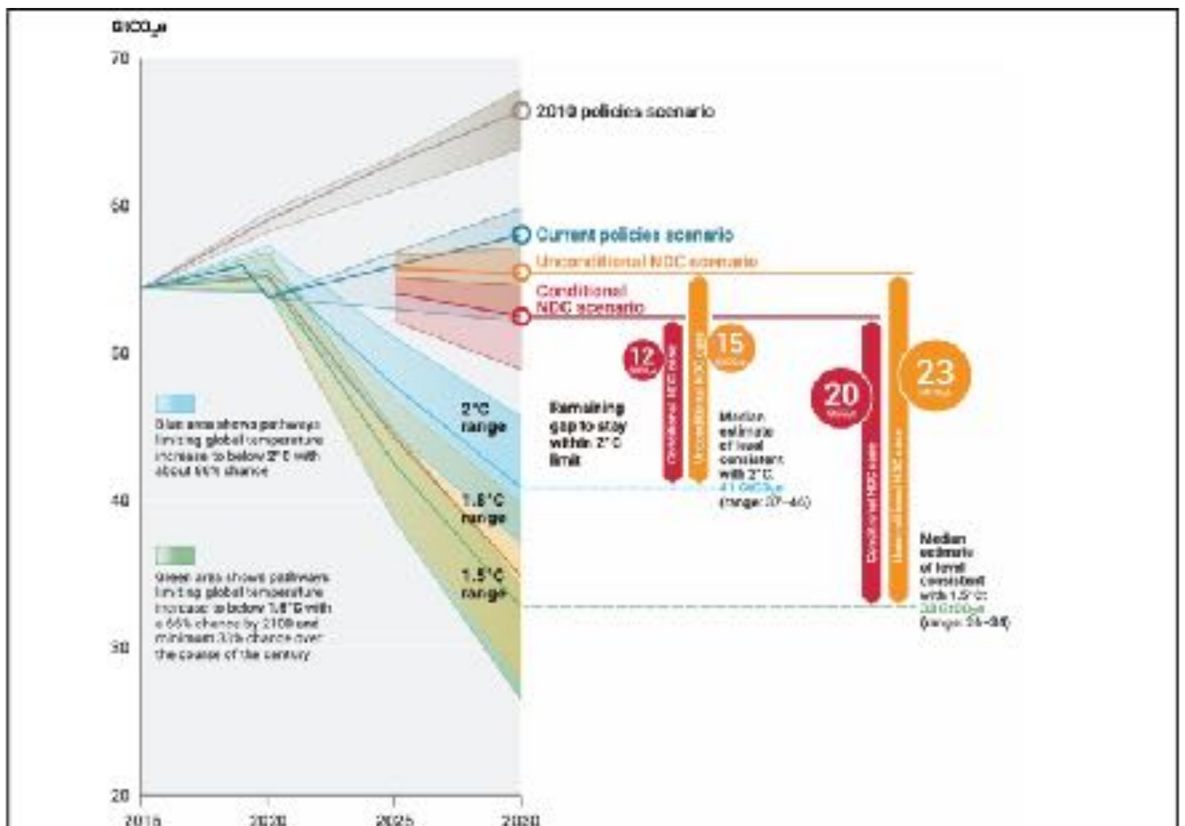
The window is closing to meet the Paris agreement targets.

Our environment is changing rapidly, putting billions of people at the mercy of severe weather, droughts, food shortage, and potential mass migration. Catastrophes that were once projected to happen in a distant future are already striking our societies.

Concentrations of carbon dioxide in the atmosphere have recently surpassed 420 parts per million (ppm), which is almost twice as much as the pre-industrial revolution levels. We emit 50 billion tonnes of green house gas (GHG) annually, increasing CO2 in the atmosphere by 2ppm, year in and year out.

To keep temperatures below an increase of 1.5°C, a turning point in terms of impact, we cannot let the concentration reach 450ppm [1]. The next 10 years are therefore absolutely critical if we want to change course, for the benefit of not only future generations but ours as well.





As individuals, we are directly responsible for about two thirds of global emissions [2]. Our impact manifests itself in the way we use energy, in how we consume products such as clothes, and in how we commute. We can therefore make a significant difference as individuals. And even small changes will help.

The 2022 emission gap report from the United Nations Environmental Programme (UNEP), entitled “The Closing Window: Climate crisis calls for rapid transition of societies” shows the depth of the problem [3].

In the past 30 years, since thousands of scientists signed the initial action charter [4], GHG emissions have increased by as much as in our entire preceding human history.

And unfortunately, there is no end in sight to our emission cravings. COVID-19 confinements put a dent in global emissions in 2020, but we came back roaring and outputs are already back where we left it off.

The UNEP report goes farther and analyse the kind of emission totals we can afford in order to remain below certain temperature thresholds. The results are staggering. In order to meet our 1.5°C ambitions, we will need to reduce our annual totals by 20 to 23 GtCO2e. The best of case assumes that international cooperation takes place (that’s what is called the “conditional scenario”). If every country acts on its own (the “unconditional scenario”), the target is billions of tonnes higher.

These numbers are indeed staggering because they represent a need for nearly 50% less emissions in the next 8 years. We will discuss why 1.5°C matters in a separate white paper. What needs to be retained here is that even at 1.5°C, the environment will be different. And above that threshold, impacts grow in much compounding ways.

The UNEP report covers a range of options to aim for the 20 GtCO2e reduction target. Among them, personal mobility is a very cheap and readily available solution. We need to reduce car commutes by as much as 15% by 2030 to help reach the target. We also need to double our use of public transport in the same period. All in, changes to personal mobility, effectively costless and even beneficial for us as individuals, can help reduce global emissions by up to 5 GtCO2e.

Engagement

A majority of today's emissions are due to our personal choices

There is a number of projects out there, aiming to help reduce GHG emissions. We would loosely classify them into two types, 1) nature-based projects [5], 2) industrial, carbon removal operations [6].

Projects seeking to bring people and companies to planting trees abound. More recently, a number of projects have started to focus on other natural sinks such as mangroves and other coastal applications. Trees' capacity to store CO_2 is extraordinary. One glance at winter CO_2 records from the Maona Loa observatory shows the impact of foliage on global CO_2 concentrations. (https://gml.noaa.gov/ccgg/trends/). Trees release CO_2 when they loose their leafs and restore it when they regrow them. The response is near instantaneous in mature trees. The draw back is that as trees die or are cut, the CO_2 nearly instantaneously makes its way back to the atmosphere as well. And it can take up to 10 years for a tree to reach a mature state of absorption, which means that the impact is difficult to achieve and even harder to maintain.

Industrial carbon removal projects are the darling (and hype) of the day. They seem to be the silver bullet that will keep us from the worst impacts. Yes, one tonne of CO2 removed via an industrial facility and stored in the ground is likely to remain there for up to 1'000 years, which beats trees many fold in terms of efficiency. But we really do not understand the potential impacts such storage might haver on the ground. And today, the cheerleaders of this technology estimate that more than 36'000 industrial plants are needed to remove enough CO2. They would have to be ran for perpetuity to keep up at current annual emissions. More would need to be built to also match projected future emission growth. With today's technology, the cost of removal for one tonne of CO2 is in the few hundred dollar range, well above costs of nature-based solutions and well above CO2 market prices, an utterly inefficient approach be financially well worth the time of projects' initiators.

We promote the idea of community based action instead. 65% of all emissions today are linked to our personal choices. Every given day, we make personal decisions resulting in more or less emissions ending in the atmosphere. Examples abound, from hot water energy use to the way we dry clothes, the type of food we consume and where it comes from and of course how we move around. Assessing and acting on each of those aspects is difficult and takes personal commitment.

One aspect that is however easy to focus on and yet very impactful is the way we move. Mobility alone drives up to 40% of our personal emissions in Europe, for instance. There is more than 1 billion cars on the planet today. Europe and North America account for nearly 600 million. Each car, on average, adds about 12'000 km and 3 tonnes of emissions to our planet each year. That's nearly 3.5 billion tonnes per year globally.

The simple fact of leaving your car home once a week can reduce our emissions by close to 1 billion tonnes. And doing so usually comes with lower costs, less risk of accidents, more healthy cities and a more healthy you as you become more active.

To make one last point on contrasting approaches. The math that governs the atmosphere (the Navier-Stokes equations) is highly non-linear. What this means is that forcings such as extra CO2 concentrations and the resulting increases in temperatures, pressure contrasts and precipitation cannot simply been undone.

When we add CO2 to the atmosphere, we modify it. Removing it afterwards will not bring the atmosphere back to its starting point. To furiously add CO2 to the atmosphere and then later remove it with industrial means only add to the imbalance. Imagine also how 36'000 carbon removal plants will alter our landscapes. After all, industrial innovation created the climate crisis. It is scary place our bets on a new industrial evolution to fix it.

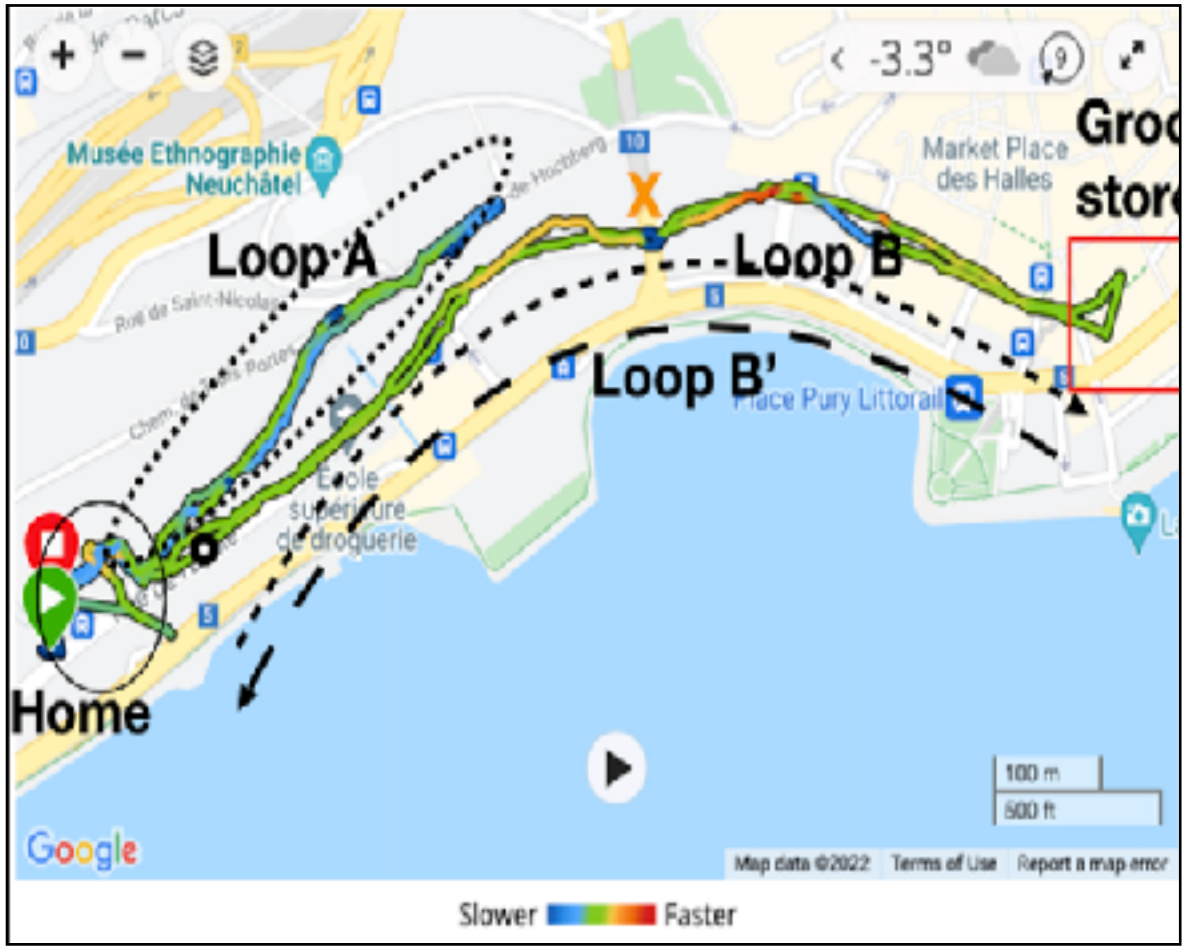
There is really no better way to abate carbon in the atmosphere than to not put it there in the first place.

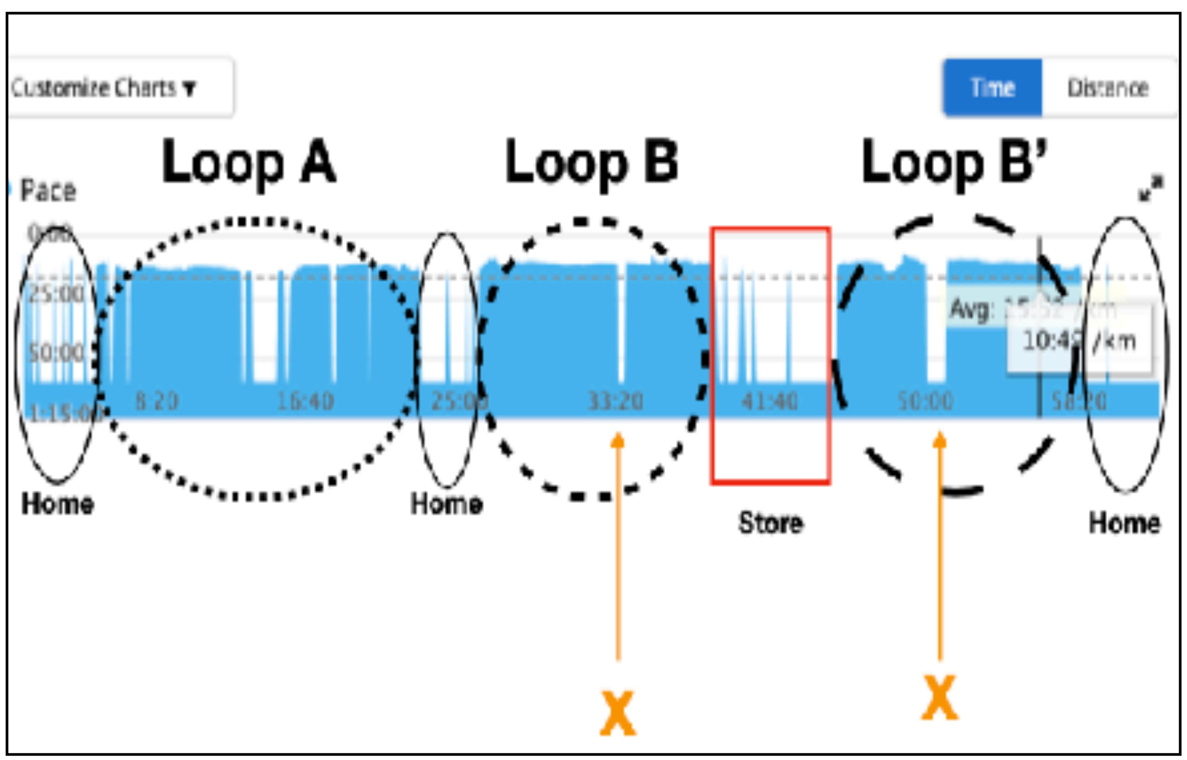
The math

We analyse & convert mobility data into carbon offsets.

We briefly describes our methodology here. A more detailed discussion can be found in our extended white paper, which is also available on our website.

Our analyses rely on the collection and validation of mobility data. We have created an App that allows users to track their movements relative to driving alternatives. For example, when walking to the local shop instead of driving, the user would simply start the App when leaving home and stop it when they get to work for instance. The App calculates the impact and display it on the screen. Further, some users, like regular commuters, may use a device and separate App – like Garmin and Strava – to record their alternatives to driving. Those activities are then synced to Quambio.





Users have to activate the App for us to record, therefore generating greater awareness of the activity undertaken and what it means in the context of their CO2 emissions.

To track the information, we use the phone GPS. We track not only positions but also signal quality in order to monitor any interruptions in data quality. This information is reported back to the user in real time.

Positions are recorded on a variable time interval basis, which depends on the type of activity underway and the consistency of the information we receive. More data is captured for activities with frequent changes in speed or direction, as well as for activities with frequent stops. Intervals vary from a few seconds to half a minute.

As the activity goes on, the data signature is analysed to determine the mode of transport, which can be either a bicycle, a train, a bus or a walk. Car trips can also be recorded, but are of course not considered in the context of our abatement method. Data elements such as speed, acceleration and their volatility in time during reference activities are used to train the algorithm.

The left panels show one of our reference activities. The App was started in a home, a few minutes prior to departing. The user then walked for a few minutes, covering a loop that brought them back to the home. After a short pause, they walked to the grocery store, stopping at the light marked with an “X” on the map. After spending a few minutes in the store, the user returned home following the same route, including going to the stop light “X” again. Finally, the App remained switched on for a few minutes in their home.

The loops labeled at B and B’ are true abatement activities.The user went shopping for grocery on foot, leaving from home and ultimately returning to it. Activity A is not an abatement. The user walked their pet during that time period. Steps around home or in an office building (an employee using the App when heading to the coffee room for instance) are discarded by the algorithm. In order for an activity to be a “true abatement”, it needs to an activity the user would have done or been able to do in a car instead. Workouts do not count, for instance.

The Quambio algorithm takes the records presented above and transforms them first into sub-activities. Each is assigned a quality score based on the recorded characteristics. Scores are assigned from 1 to 4.

A score of 1 means that the activity can be considered an abatement. Loop B and B' are examples. A score of 2 means that the activity indeed involved soft mobility, such as walking or biking. However, those activities are not abatements but rather meant for leisure or repetitive chores such as walking the pet. Activity A receives a score of 2 in the example above. We have several additional scores. A score of 3 indicates that the user was in a car. A score of 4 menas that the activity purpose or mode of transport is unknown.

From the data signature, the algorithm determines the type of activity, ie the score, as well as the mode of transport. This information is stored along with the detailed positions for each activity and for sub-activities. This information is shown to the user in real to near-real time, which provides additional cross-validation.

Furthermore, the Quambio algorithm then calculates the impact. Activities with a score of 1 receive a CO2 abatement estimate. Activities of score 1 and 2 earn the user cubes, our in-App currency.

The calculation of abatement is based on the parameters of the activity, its duration and distance and the mode of transport. We also track elevation but do not explicitly use that parameter yet.

Calculations are performed against the baseline of a petrol car with ana average fuel efficiency and emission profile. For each km covered, a fuel consumption and emission is computed and part of it abated based on the mode of transport. We consider that the entire emission is abated by someone on foot. Bicycles retain a residual level of emission linked to the cost of its production, shipment and maintenance. Bus and trains retain additional levels of emissions per km.

Factors are built to determine the level of abatement. The factors vary as a function of distance, as cars are known to produce more emissions when they are still cold, during the first few kms. The first few kms are also generally in town and villages, with all their stop-and-go situations.

On long distances, we assume that cars hop on highways where the consumption is reduced. The algorithm takes this dimension into account, “suppressing” the abatement per km on long distance trips.

As the data is rigorously validated and scored based on detailed information, all activities scored as 1 are high quality abatements. They truly represent carbon that was not emitted, i.e. the best way to abate CO2 from the atmosphere.

To reach our set temperature objectives, indispensable to offer future generations the same opportunities we have benefited from, we need to engage individually and actively into the issue. What we offer is a solution to nudge people in that direction. While other removal and abatement techniques are needed, they alone will not be able to match emissions trends that assume the same consumption patterns. This is a reality that we need to face together today.

References

[1] https://www.ipcc.ch/sr15/chapter/spm/
[2] https://iopscience.iop.org/article/10.1088/1748-9326/ab8589
[3] https://www.unep.org/resources/emissions-gap-report-2022
[4] https://www.sciencedaily.com/releases/1997/10/971002070106.htm
[5] https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0120
[6] https://link.springer.com/article/10.1007/s41247-020-00080-5

Conclusions

The best way to abate CO_2 is to not emit it.

The objective of the Paris agreement, to keep global atmospheric temperatures well below 2^{o}C, cannot be achieved without systemic societal changes, including in how we act towards our emissions.

Our personal choices drive more than 50% of today's emissions. Yet, in order to achieve the 1.5^{o}C target, we need to decrease our emissions by nearly 50%. Therefore, no realistic pathway to 1.5^{o}C exists that does not reflect some level of personal action.

Making collective changes to our individual emissions is however, without a doubt, difficult. Doing so in the mobility space might be a low hanging fruit. It costs nothing extra to leave a car home once in a while and walk instead, or take a bus. In fact, with today's fuel costs, driving less will result in savings. Walking also has proven health benefits as well as a positive impact on urban environments.

When in comes to personal mobility, the number of kilometres of public transit must be doubled in order to support the 1.5^{o}C temperature pathway. At the same, the number of trips involving personal light vehicles (cars, motorcycles) need to be reduced by up to 15%, according to the UN.

In contrast, one could argue that nature-based solutions and industrial carbon removal facilities will produce the kind of reductions to put us back on track for the 1.5^{o}C target. They do have a role to play, but neither class of solutions will suffice not come to bare soon enough.

Our method which is based on the idea of rewards for action, community based, ludique yet quantitative offers an alternative vision for removals.

Because the atmosphere is complex and non-linear, removing after adding is not a zero sum game. Ultimately, there is no better way to abate CO_2 than to not add it to the atmosphere in the first place.

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