Climate change and carbon emissions: scientific context for local carbon mitigation initiatives at Gomde UK Tibetan Buddhist Centre

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Introduction

Despite ever-expanding technological sophistication and economic wealth, society faces dramatic environmental risks as the capacity of the natural world to support current levels of human activity and consumption comes under strain [2-6].

A balance is needed between societal well-being and the health of the 'earth systems' that provide the physical and ecological basis for life and society. Human-induced pressure on the environment is driving it towards major tipping points, the 'planetary boundaries' at which point new and important risks arise for society [7-9].

Global warming, a result of humans' combustion of fossil fuels, directly or indirectly exacerbates stress on other earth systems (e.g., freshwater, land cover, ocean water quality [acidity and temperature], sea level rise, and biological diversity) [10-17].

The most recent temperature data (Figure 1) shows a map of temperature anomalies for the northern hemisphere cold season (Nov 2020 to April 2021). Drastic warming in the far north is now a regular occurrence, where Arctic temperatures ran 2.0- to 6.0-C warmer this past winter compared to the mid-20th century baseline.

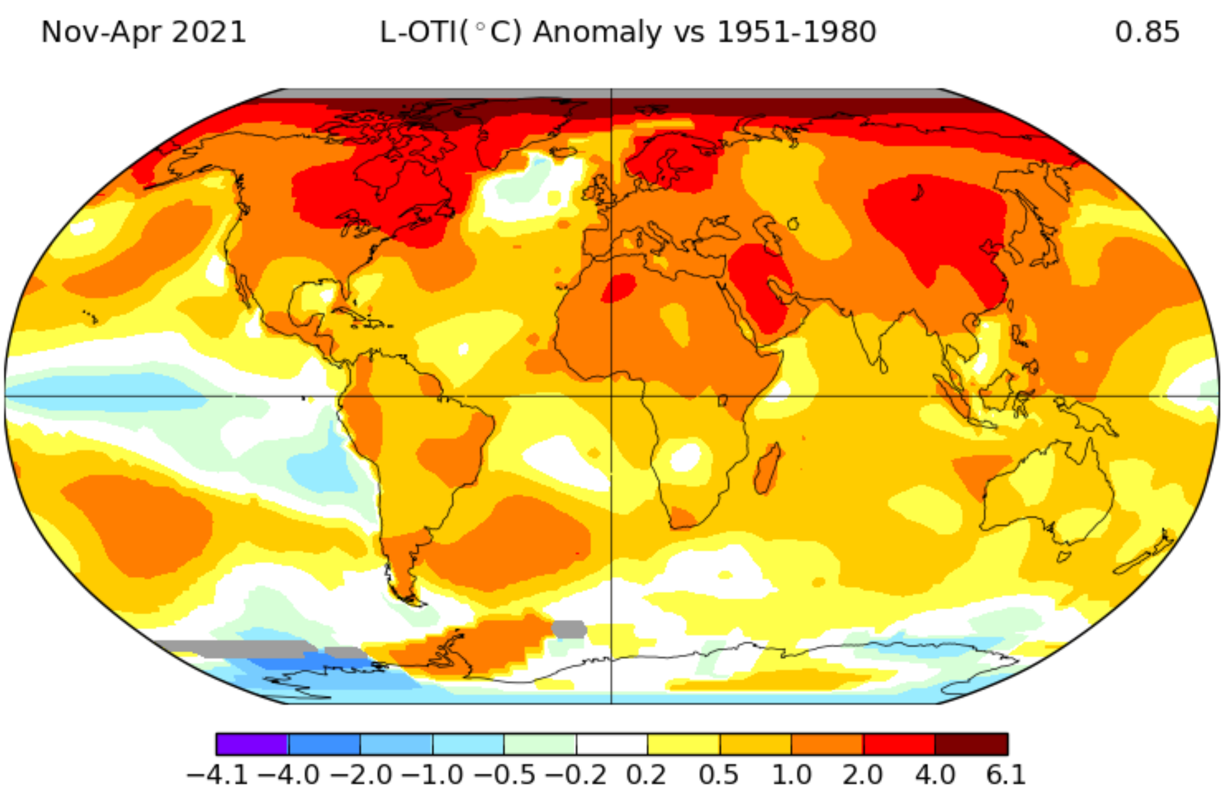

Figure 1 – Map of global temperature anomalies for the northern hemisphere winter, Nov 20-Apr 21 (https://data.giss.nasa.gov/gistemp/maps/)

Carbon is a global pollutant: each metric tonne (mt) of carbon in the atmosphere, wherever in the world it is originally emitted, contributes to the global stock of atmospheric carbon that inevitably is warming the planet. Individuals, households, companies, governments, and other organizations around the world will need to act collectively to reduce carbon emissions to the atmosphere and control the emerging risks posed by a dramatically warmer climate.

This paper provides some background scientific and technical context about global warming[i], laying the groundwork for discussing and implementing climate change solutions for Gomde UK Tibetan Buddhist Centre. While Gomde's contribution to global carbon emissions in miniscule in the big picture, it is clear that all individuals and organizations need to do their part in helping to control the climate emergency.

Carbon emissions and its influence on climate

The earth's climate has fluctuated greatly over geological time scales[ii]. Figure 2 shows that the earth has been through warm periods with no polar ice caps (red, the zone above the horizontal dividing line in the graph), when temperature exceeded roughly 19 C (66 F), and cool periods when ice caps were present (blue, the zone below the horizontal line).

At this scale, representing 500-million years of earth's climate history, even the sharpest up and down movements of temperature have taken tens to hundreds of thousands of years.

The human species, *Homo sapiens*, only emerged as a species roughly 300,000 years ago and started farming less than 10,000 years ago, an imperceptible blip at the right end of the chart.

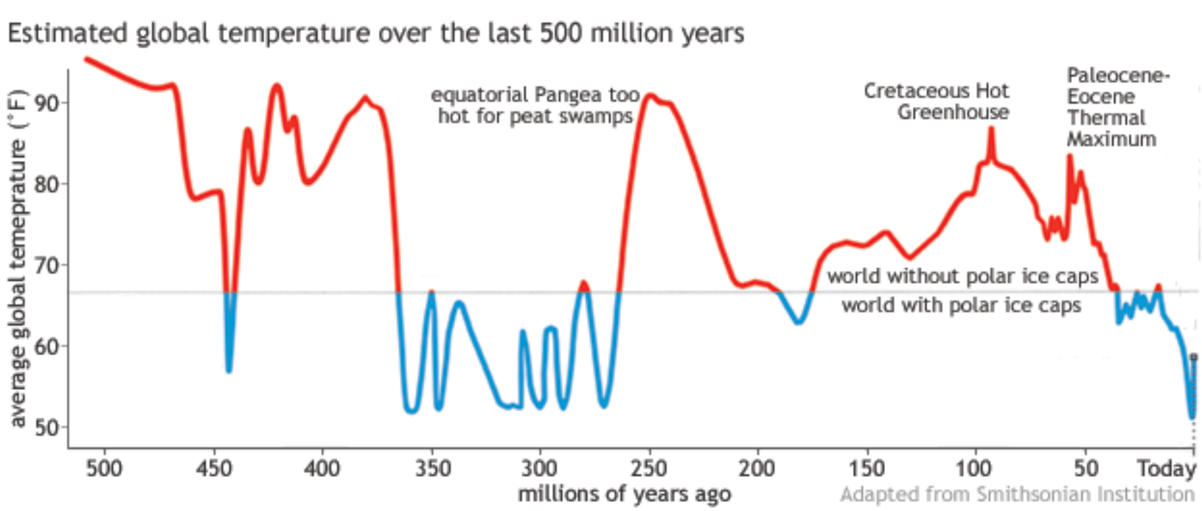

Figure 2 - Average global surface temperature (https://www.climate.gov/news-features/climate-qa/whats-hottest-earths-ever-been)

Figure 3 breaks down the last 20,000 years in more detail. Since the start of the industrial revolution, and particularly after WW2 [8], emissions from the fossil fuel combustion have increased dramatically. By

1950, carbon concentrations in the atmosphere hit 300 parts per million (ppm), the highest level of earth for over 800,000 years; by 2019, atmospheric carbon concentration reached 410-ppm.[iii]

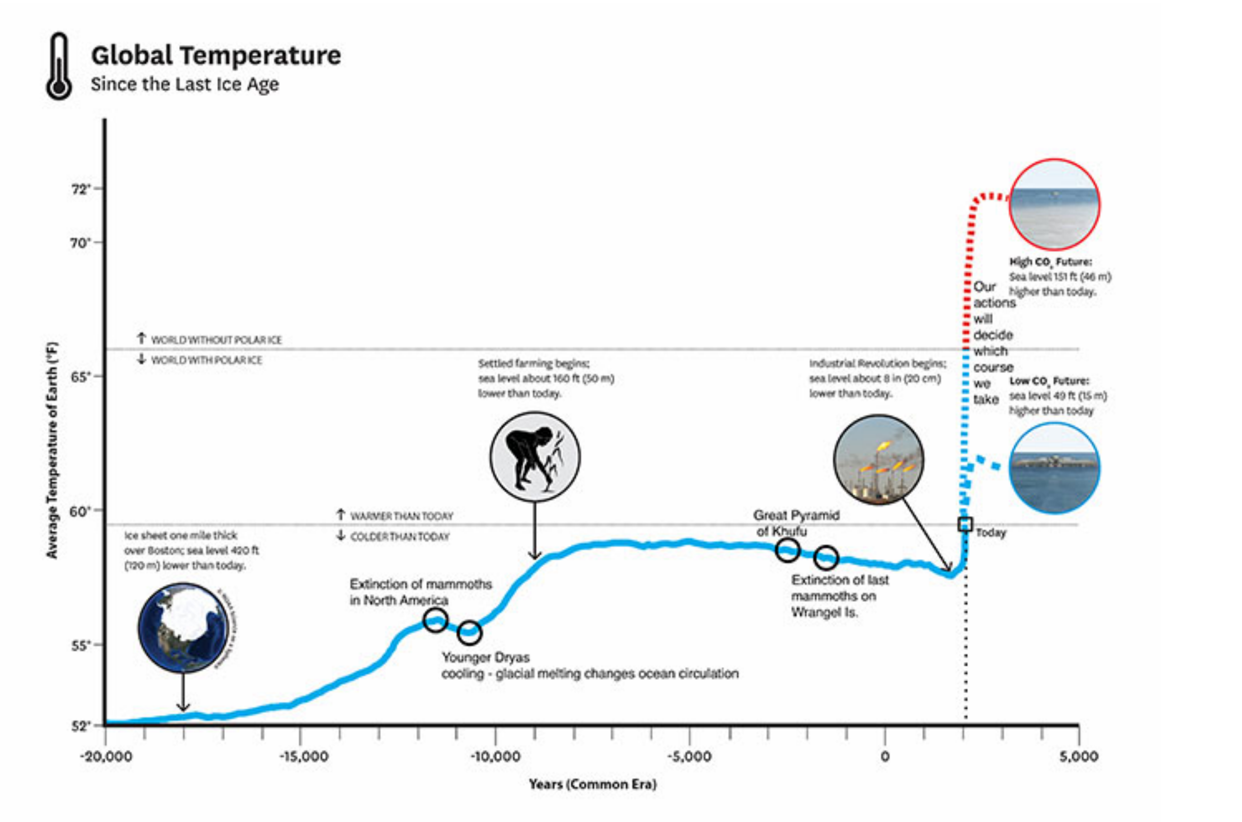

Figure 3 - Global temperature over the last 20,000 years: the red color shows a high carbon future scenario that would push temperature back into the red zone shown in Figure 1 (https://www.smithsonianmag.com/science-nature/paleoclimate-timeline/)

Carbon in the atmosphere is the precursor to a warming climate, setting in motion the changes in earth systems that will also result, at a lag, polar ice cap melting, sea level rise, ocean warming and acidification, and changes in ocean circulation patterns [18].

Figure 3 also shows a range of future global temperature predictions based on current international modeling efforts. At the high-end of mainstream model predictions, global mean temperature could jump by 4-C or more, pushing the earth to the warmest it has been in some 17-million years.

Box 1: Climate models

Climate scientist globally are constantly refining climate models [1] and use a series of standardized scenarios to project how carbon in the atmosphere will affect global average temperature over the next century. 'Ensemble models' are run thousands of times, each run with different parameters changed slightly to ensure that a full range of plausible and possible outcomes are discovered. Those outcomes from the basis for international discussions about the quantity of, and speed at which, carbon emissions must be reduced to control the risk of catastrophic climate change impacts.

For anyone who watches weather reports during hurricane season, the idea is similar – thousands of runs of hurricane path simulations by independent modeling groups in the UK, USA, Europe, and Canada provide summary information on pathways a storm may take. Ensemble model outputs allow for the construction of a most likely track and a cone of possible tracks that are less likely, but still possible (check out https://weather.com/science/weather-explainers/news/spaghetti-models-tropics-tropical-storm-hurricane for more detail on hurricane ensemble models). As time goes by and models incorporate better data as real-world observations come in (e.g., from planes that fly into the eye of the storm), models converge onto a storm path that is highly probable, thus giving crucial information to people in the hurricane's path regarding the timing and severity of the likely impacts such as wind speed and sea level surge.

All the global warming evidence compiled by international scientific modeling teams now points to a 'storm track' the likes of which has never been experienced in earth's history, the rapid vertical bend in average temperature forecasts seen in Figure 2.

Does the situation constitute a 'climate emergency'?

Carbon and other greenhouse gases such as methane (collectively known as GHGs) that warm the atmosphere have already jumped in a geologically significant way in a *time span of less than 100-yrs*.

To humans 100-yrs may appear to be a very slow pace of change, but in geological time this is virtually instantaneous (this level of change would normally have taken tens or even hundreds of thousands of years).

If carbon emissions are drastically cut back, we are likely still committed, based on our legacy of carbon emissions from historic industrial development, to a global temperature rise of 2.0-C (the lower future projection in Figure 2) [4, 18]. If we stay on a trajectory towards more pessimistic (but completely feasible) scenario outcomes, temperature increases of 4.0-C or more are likely.

Remember, we live in a world where it was difficult to get people to wear masks during a 2-year global pandemic: controlling global warming will require changes in individuals' lifestyles over a time scale of generations, so there is quite a strong reason to believe that carbon emissions and temperature increases will tend towards the high end of the range of modeling estimates.

While a 2- to 4-C temperature rise may not sound like much (isn't more summer weather a good thing?), that level of temperature change would drastically change global food production patterns [6], induce a variety of human health problems [3, 5, 19], threaten important cultural dimensions of people's lives and livelihoods [20], lead to large-scale migrations of climate refugees [21], and exacerbate the risks of military conflict in situations where water and food supplies were in flux [22]. In addition, there is likely to be the need for massive long-term defensive infrastructure investments to protect low-lying cities and agricultural land against sea level rise [23]. On top of this, global warming will have spinoff effects as an additional stressor on marine, freshwater, and terrestrial ecosystems.

From a human perspective, already there are skewed distributional impacts of climate change, with the costs associated with damages from carbon emissions largely accruing to the world's poor [4].

The global warming stakes appear exceedingly high for future generations. Any reasonable assessment should conclude that our current situation does, indeed, pose a climate emergency.

Controlling carbon emissions and warming

Differing strategies to address global warming

The only way to constrain global warming will be to keep carbon (and other greenhouse gases like methane) from entering and staying in the atmosphere. Simplifying greatly, there are currently two broad strategies available to do this.

First, with an emphasis on **adaptation**, society might continue to build economic wealth, increase education levels, and improve human health, pulling large parts of the global population out of poverty. Those factors give society a much higher level of 'adaptive capacity' when warming happens. The broad argument for adaption assumes that if we enhance adaptive capacity, it will be possible to strategically develop and invest in emerging technologies (e.g., carbon capture and storage, geoengineering) that will ultimately be most effective technological tools for controlling carbon levels in the atmosphere.

If we squander money now on investments that have no real impact on carbon emissions over the long-run, we reduce our long-term adaptation potential (this was precisely the argument used against the first major climate change agreement, the Kyoto Protocol – even with the very large economic cost of implementing the Kyoto Protocol, projections were that it would have minimal impact on actually slowing warming). Society, the adaption argument goes, may be better off to just to keep the economy growing, improve quality of life for citizens globally, and maximize humans' adaptive capacity for if and when it later became really necessary to respond to warming.

The second school of thought, with an emphasis on **mitigation**, posits that global warming is an existential risk that could threaten the very viability of human society over the long-term [24]. The analogy of an asteroid approaching is sometimes used [25]: if we know an asteroid will hit earth 100-yrs in the future, we certainly would not be waiting 90-yrs to do something, hoping that technological advance would help us solve the problem then.

Advocates for the mitigation-oriented perspective argue that it is imperative to undertake all feasible measures to control global warming now, and that rapid investments are needed to cut off the cause of warming – carbon emissions – at the root. Due to the tremendous uncertainty society faces, the prudent action is to minimize the risk of catastrophic run-away warming, not maximize economic output, the predominant focus of most governments.

This is obviously a simplification of some complex views on the challenge, and there is substantial overlap between some measures that contribution to both adaption and mitigation. There are advantages and disadvantages to specific approaches, and it is clear that a broad suite of measures will be needed, and that action is taken to ensure that the measures remove carbon from the atmosphere permanently [26].

Technological solutions

In 2007, international consulting firm McKinsey led the first major effort to address how different technological investments might be made to mitigate, or curtail, global carbon emissions. They used something called a Marginal Abatement Cost (MAC) curve [27] to illustrate their findings. Figure 4 shows a stylized version of a MAC curve with different technologies that may help reduce carbon emissions [28].

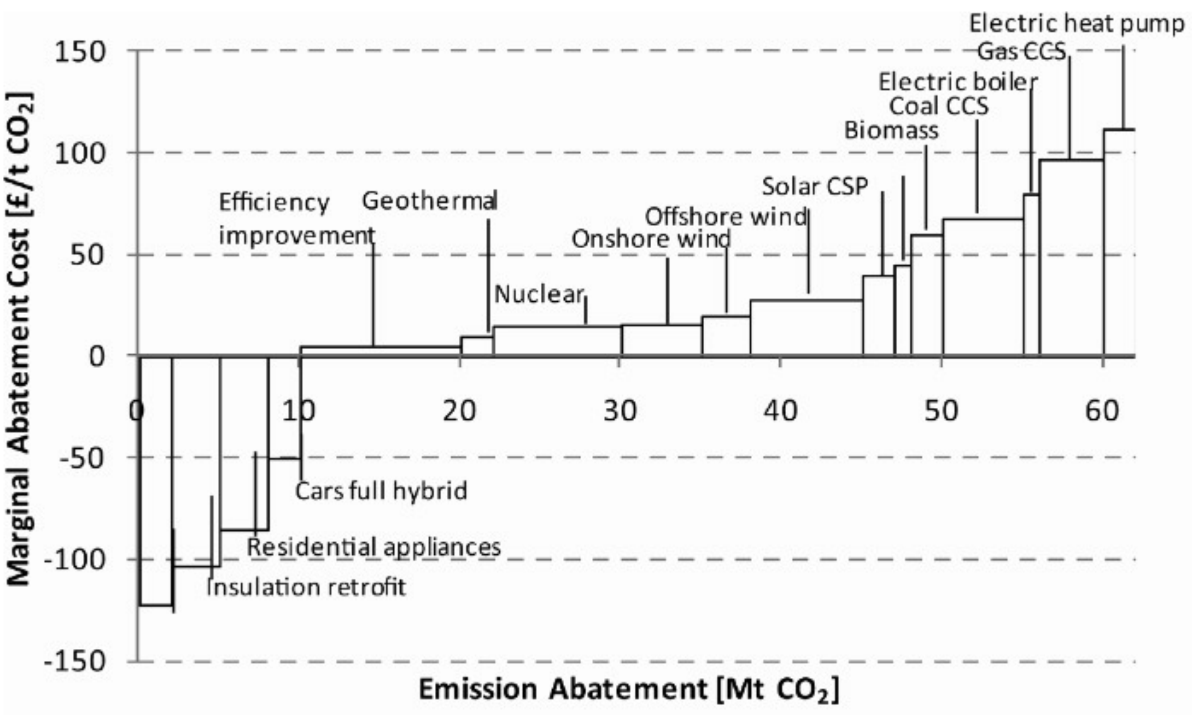

Figure 4 – A stylized MAC curve [28]

The vertical axis shows the incremental cost, for a given technology, to prevent the emission of one mt of carbon into the atmosphere. At the left side of the chart, the price of some technologies is substantially less than zero, indicating that investing in these technologies – mainly low-cost conservation efforts – could simultaneously mitigate carbon emissions and provide a financial pay-off, recouping up-front investment costs. These are the 'win-win' investments for controlling global warming (of course, one must have the financial capacity to invest in mitigation initiatives up-front even if it will save money in the long-term).

On the right side of the chart, expensive new technologies such as carbon capture and storage (CCS) would come into play. The technological solutions in the MAC curve are put in order, from most to least economical. The costs of preventing one mt of carbon entering the atmosphere thus rises for technologies going from left to right in the chart, giving it the name 'marginal abatement cost curve.'

The horizontal axis shows the total mitigation that all the technologies together could achieve. Some bars are skinny because they have relatively modest capacity to reduce emissions, and others are thick, indicating that those technologies have the capacity to make a real dent in emissions.

For example, nuclear and geothermal have roughly the same mitigation cost per mt of carbon, but implementing large-scale nuclear plants has the potential for a remove a much higher volume of carbon from the atmosphere compared to geothermal (nuclear can be done on a larger scale, substituting for many more coal-fired generating plants than geothermal could manage; of course, widespread deployment of nuclear power comes with its own unique set of risks).

A MAC curve can be made to make the 'business case' for different types of mitigation investments – those measures with potential cost savings and the scope to mitigate substantial volumes of emissions are the 'low hanging fruit' that are logical places to start mitigation efforts. As more and more of the 'easy' measures are implemented, mitigating that next mt of carbon becomes progressively more expensive as new technologies are developed and deployed to take even more carbon out of the atmosphere.

Ecological solutions

Beside the deployment of mitigation technologies, carbon can also be removed from the atmosphere using a variety of ecologically-oriented measures.

Carbon is captured by the photosynthesis process; if plant growth can be managed in a way that it binds carbon over the long-term, then it can be an effective mitigation strategy. For example, if forests are grown, and then burned for energy production, carbon is relatively easy to capture at its source when it is burned (compared to pulling it out of the atmosphere later). That captured carbon can then be deposited into geological reservoirs stable over very long periods.

There is currently a major biomass-oriented mitigation focus internationally with an emphasis on forest and wetland management and rehabilitation (including peatlands[iv]). The UN initiative known as REDD+ (REDD stands for 'reduce emissions from deforestation and forest degradation') aims to increase forest conservation and growth, particularly in the tropics where forests are under pressure due to logging and land conversion to agriculture.

Environmental economists typically ascribe a value of about ₤70 to the damage avoided by reducing carbon emissions by 1-mt [29] (this damage is known as the 'social cost of carbon', and includes a broad range of factors from food production costs to medical costs related to temperature extremes). Governments that recognize the economic benefit of reducing carbon emissions frequently offer financial incentives to organizations that are early adopters of mitigation technologies and measures.

In the UK, both peatland restoration and expansion of forest lands are recognized as environmental priorities [30] because both can provide multiple types of benefits, including carbon mitigation. Given the market price of carbon is already around £50 per mt in the UK carbon trading market[v], should mechanisms be developed that make payments available to landowners for carbon-oriented land management, it could very much alter current land management practices and patterns.

Social solutions

Besides technological and ecological mitigation efforts, it is also possible for individuals and organizations to adapt their behavior in order to help curtail carbon emissions into the atmosphere.

Two lifestyle choices loom particularly large: carbon emissions are especially influenced by diet (plant- versus meat-based foods can have very different carbon footprints[vi]) and by air travel, where frequent-flyers who comprise just 1% of the world's population generate half of the global aviation industry's carbon emissions [31].

Food and household good consumption choices have important implications for international transportation network carbon emissions. Reducing food waste also has an important role to play at the household level[vii].

Income inequality plays a major role in the global emissions picture, with the top 10% of world population being responsible for about 34% of household-related carbon emissions [32]. In India and China, there are stunning differences in consumption levels between economic elites and average citizens [32] (whereas in North America and parts of Europe, there are relatively high levels of consumption across almost all income levels).

Solutions that encourage sustainable consumer behaviour often take the form of campaigns to shift social norms via formal social marketing exercises [33] or informal initiatives to demonstrate climate-responsible behaviour (e.g., Greta Thuneberg's choice to travel by ship to North America in 2019[viii]).

Governance solutions

Governments have the capacity to influence the behaviour of citizens through a wide variety of regulatory and non-regulatory (e.g., financial incentives, education and awareness-building) measures. National governments also have the ability to engage internationally with various treaties and initiatives meant to help deal with global warming.

The Paris Agreement[ix] provides the framework for international cooperation on efforts to control global warming via voluntary national commitments to reduce carbon emissions. While the Paris Agreement is a step in the right direction, providing verifiable carbon emission reduction targets and programmes that will help finance such reductions, there are still large hurdles to overcome.

In particular, it is important to be aware that important divides exist between the high-income and low-income countries when it comes to how countries should share the economic burden of controlling global warming. Simplifying greatly, the crux of the matter relates to how the 'pain' of reducing carbon emissions is divided up among high- and low-income countries [34].

Wealthy countries became rich by using carbon-intensive industries to build wealth over time. They argue that everyone, including the countries just starting on the development path, now have to share carbon mitigation responsibility based on a country's current emission levels. Developing nations that have recently and rapidly increased carbon use (i.e., China, India, and Brazil) have reacted skeptically regarding any proposal to proportionally share mitigation responsibility based on current emission levels because their cumulative burning of fossil fuels has to date accounted for only a fraction of the carbon already in the atmosphere.

The slow pace of international climate diplomacy reflects the huge challenges in reconciling these very different perspectives. International posturing over global warming policy can complicate negotiations, as government statements may actually be meant for domestic political purposes, not for the goal of minimizing risks of global warming [34].

At the national level, it is possible for governments to move forward on climate change policy and initiatives in a coordinated way, although the deconstruction of climate-related regulations in the USA under the Trump administration clearly demonstrated that policy reversals are always possible.

In the UK, global warming has long been recognized as an important threat and there have been efforts to ensure that climate-related policy action also has 'co-benefits', such as biodiversity conservation, as well as new economic development opportunities [30, 35]. The *UK Climate Change Act* was enacted in 2019 and it's 10-point plan for achieving carbon neutrality included a focus on reforestation and rewilding.

At the local governance level, the importance of city and municipal governments is widely recognized [36] due to the level of influence they have over things like planning, building codes, and transportation choices.

In the Gomde UK context, the government of Doncaster has published their 2020-2030 Environment and Sustainability Strategy [37], which puts substantial emphasis on carbon-oriented management and rehabilitation of natural areas and peatland, and the co-benefits that such a strategy provides for biodiversity, human communities and households, and the economy.

The Doncaster aspiration is to be carbon neutral by 2040, so any initiatives at Gomde UK will contribute to carbon mitigation goals within the Doncaster regional context.

The carbon emissions gap

After seeing all the possibilities for reducing carbon emissions outlined in the prior section, one might think that society will succeed quickly in addressing the climate emergency.

Unfortunately, that is not likely the case because society faces a stark 'carbon emissions gap.'

Even if society undertook all available currently technological feasible measures and achieved voluntary targets pledged under the Paris Accord (a long shot given the commitments are voluntary), there will still be far too much carbon in the atmosphere to constrain global warming to a 'safe' level of a 2-C increase.

Figure 5 shows current carbon emissions scenarios and the range of predicted temperature increases for each (the 'storm track' scenarios). The upper red curve, the 4-C pathway is commonly referred to as the 'business as usual' scenario. The middle (blue) and lower (green) curves are typically viewed as the 'realistic' and 'aspirational' low carbon futures, where society engages in quite aggressive de-carbonisation of the world economy and keeps global warming to somewhat manageable levels.

Current modeling suggest that average global temperature rise will be in the 3.2-C range over the next 75-yrs [4], better than the most pessimistic 'do nothing' scenarios but high enough to have major, and potentially irreversible, environmental and social consequences.

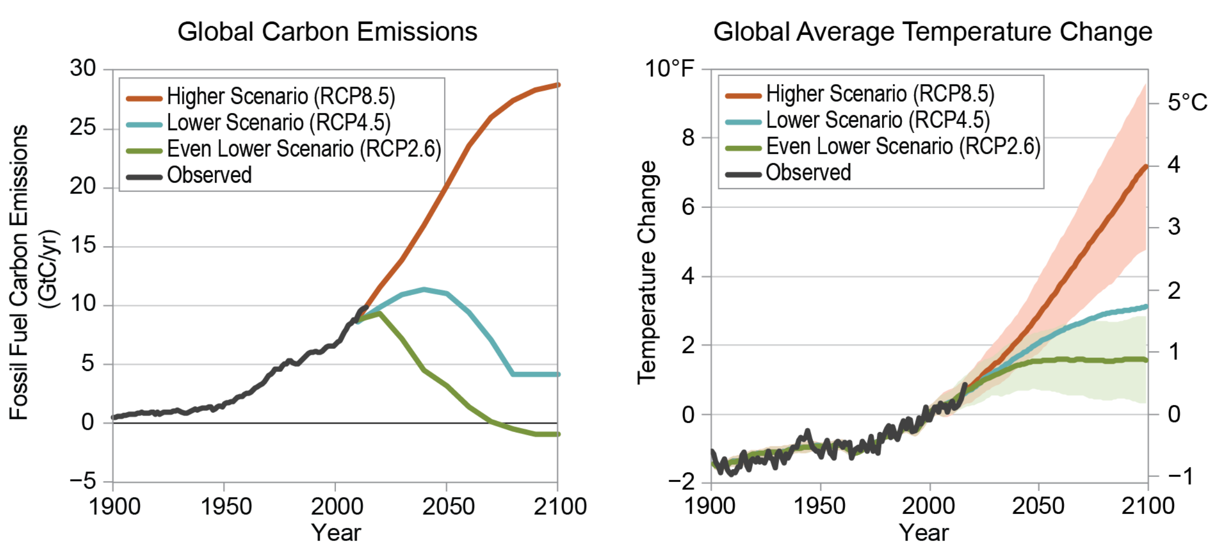

Figure 5 – Carbon emission projections (left) and temperature increases (right) for three standard scenarios used by climate scientists [4]

Even when carbon emissions decline in magnitude, it is important to understand that global warming at best flattens or, more realistically, continues to rise at a reduced pace relative to inaction.

Think of the global atmosphere as a bathtub that is slowly getting filled up with carbon: even if we slow down the flow into the tub – curtail carbon emissions – until society achieves net zero carbon emissions (i.e., roughly 2070 in the most aggressive de-carbonisation pathway in the graph on the left), the tub continues to fill, albeit at a slower pace than in the past.

By 2030, the 4-C pathway would have the world at about 15 gigatonnes of carbon emissions annually while for the 1.5 C pathway, emissions would need to be constrained to about 5 gigatonnes.

Society does not currently know how, technologically, to achieve that reduction, even if we used all the high cost (right end of the MAC diagram) technologies we now have at our disposal.

Technological optimists hope that new carbon capture and storage (CCS) technologies currently being designed and tested will play a central role in future years, but realistically large-scale and economically viable CCS technologies are unlikely to be available until beyond 2030.

Gomde UK efforts to reduce carbon emissions

Since its inception in 2010, Gomde UK has worked to increase its level of environmental sustainability. An important component of this effort has been to reduce the carbon emission footprint of the centre, even while centre has expanded its scale of operations. Even though Gomde UK's carbon contribution is tiny, efforts to reduce emissions are based on the recognition that what can be done should be done.

The reduction in local carbon emissions is the result of both investments in physical infrastructure and in modifications to on-site practices affecting energy use (Figure 6), and has to date included:

- Installed photovoltaic system (2011) (which reduced electricity use and also gave Gomde UK access to an extra income stream from a government grant programme);
- Moved to all vegetarian meals (reducing the relatively high carbon footprint from livestock farming[x], one component of the diet originally in place during Gomde UK's early years);
- Increased on-site food production (reducing food purchase requirements for products with a higher carbon footprint due to national or international transportation requirements); and
- Installed a wood gasification boiler (2016) (which reduced heating fuel oil needs and also attracted government grant income).

The point labelled ① marks the starting point for Gomde UK, after the purchase of the property. If Gomde UK were to have been operated like a typical conference centre or hotel, carbon emissions would have trended upwards over time as the operation scaled up. That is the 'did nothing' pathway (the equivalent of the global 'business-as-usual' scenario but at the individual organizational level).

Instead, shortly after the property purchase, Gomde UK started on a path to reduce carbon emissions by installing a photovoltaic system in 2011. That provided 'free' self-generated electricity for Gomde UK operations and provided Gomde UK with a stream of income from the government incentive payments. The grant was implemented by the UK government because it already recognized the social costs of carbon damage to the economy and was providing incentives to generate more electricity from renewable sources.

Also contributing to the downward trend in emissions were initiatives at Gomde UK to more on-site production of food and the elimination of meat from meals for centre staff and guests.

In 2016, the pathway took another downward bend, at the point labeled ②, after the installation of the wood gasification boiler, which again reduced energy costs on site and generated additional grant income reflecting the government's ongoing efforts to incentivise moves away from fossil fuel.

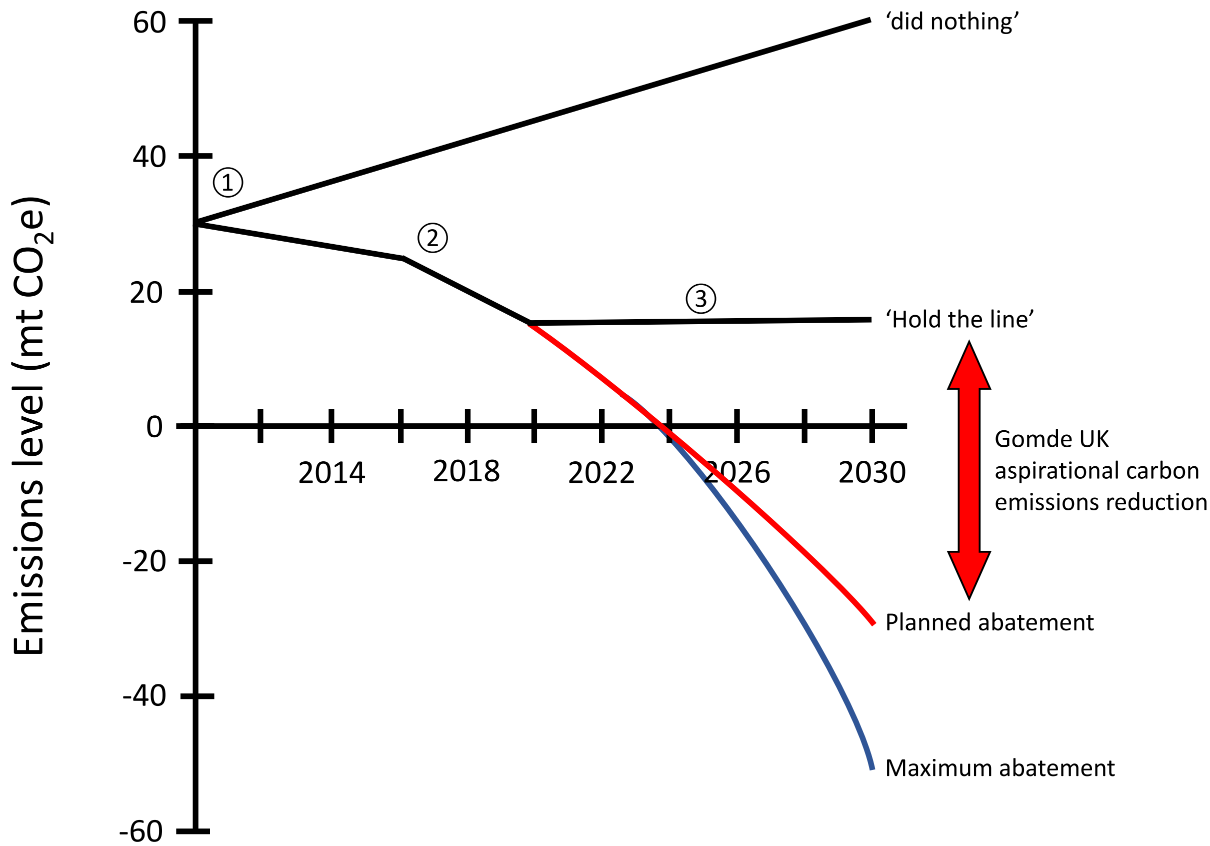

Figure 6 – A schematic of Gomde UK's carbon emissions[xi]

If Gomde UK was to take no more action to reduce emissions from 2021, overall emissions would stabilize (the horizontal line starting at the point labeled ③) at a level of about 40% lower compared to year 1 of operations, and roughly in the range of a 50-60% reduction compared to the 'did nothing' scenario.

Current plans for future Gomde UK development include the addition of heat pumps and expanding solar photovoltaic capacity with modern high-efficiency panels. That alone should move Gomde UK to carbon neutral status or even to net positive status. Those measures may also generate income (via sales of electricity to the grid and/or drawing government incentives to help reduce national carbon emissions), a 'win-win' situation for the organization and the environment. That would cut roughly an additional 40-mt of annual carbon emissions over the next decade (the red pathway that leads to the arrows indicating the Gomde UK aspiration for carbon emission mitigation).

Even the win-win investments require sufficient financing so that they can be implemented, so communicating the financial and environmental benefits of more sustainable construction technologies needs to be framed in a way that donors/supporters understand how upfront financial contributions contribute to both environmental and financial sustainability for the centre over the longer-term.

In addition to the physical and technological options to reduce carbon emissions over the next decade, additional measures to mitigate carbon emissions may be possible, potentially shifting the pathway down even further (the bottom blue line). These might include:

- Produce more food on Gomde UK property (which serves as a substitute for food that must be transported from other regions or countries);
- Increase carbon mitigation in the property forest and degraded peatlands on and adjacent to the centre; and
- Reduce emissions associated with national and international travel (e.g., using virtual meetings whenever possible and when meeting in person, undertake carbon offsetting to mitigate for meeting-related travel).

Some of these measures to mitigate carbon emissions have the potential to also generate cash flow for Gomde UK. In the future, it may be possible for Gomde UK to tap into carbon sequestration credits, making it possible to use carbon-oriented land management to generate income streams.

Conclusions

Engagement needed at all levels

The scientific evidence now overwhelmingly suggests that: (1) human society faces a looming climate emergency; (2) that virtually all technological measures now available need to be implemented to help control it; and (3) that even if all current technologies are deployed, there will still be an emissions gap to fill to keep the world from warming beyond 2-C.

This implies the need for widespread action at all levels of society, from governments all the way down to private companies, households, and non-profit organisations. One 2012 study put forward a suite of measures that at that time partially filled the emissions gap and argued that the "fundamental key for the success of 'wedging the gap' is to build a coalition of globally leading organizations in the world of business, governments, NGOs and the international community" [38].

Filling the emissions gap will require changes in human behaviour and lifestyle, especially among the world's richest consumers. It will require long-term and major changes in consumption of fossil fuels, the basis on which the rich have enjoyed lavish lifestyles and developed nations have built up physical and social (e.g., health care, education systems, etc.) infrastructure.

Achieving widespread behavioral change to reduce carbon consumption will be a great challenge (after all, who would have thought two years ago that people would refuse to wear a mask or get a vaccine in the midst of a global pandemic?). On top of the challenges in nudging behaviour in a more sustainable direction, a coordinated response to global warming is complicated by misinformation campaigns designed to deliberately confuse people for political purposes or to delay regulatory actions that could hurt corporate profitability [39, 40].

All this points to the crucial need for all individuals and organizations to engage in climate solutions, no matter how 'inconsequential' in the overall scheme of things. The more that can be done now, the more options remain open for the future once economical carbon capture technologies come online.

Buddhist solutions?

Change is coming as the planet warms. The scale of the challenge also highlights how some fundamental changes in how peoples' worldview could be of benefit in the struggle to control global warming. This is nothing new on its own, and the need for changes in ethics and values been highlighted by modern environmental scientists [41] as well as by authors of some of the early environmental classics from the mid-20th century [42] and a wide variety of environmental philosophers, writers, and activists.

Earlier in the paper, technological, ecological, social, and governance solutions were outlined, measures that might be used to help address the challenge of global warming. The role of human values, and in particular the modern form of consumerism that seems to equate well-being with consumption for its own sake, will also need to be adjusted in light of the climate crisis, or the environment and future generations may pay a very steep price.

As a Buddhist community and organization, there are aspirations at Gomde UK to 'do no harm' and to 'help if we can.' Buddhist aspirations could be beneficial in the effort to control global warming should they also be adopted by individuals and organizations outside of the Buddhist world.

This raises question as to how best Buddhist organizations can help to catalyze climate-friendly changes in behaviour within and beyond the Buddhist community, and whether there are some uniquely Buddhist solutions that can be applied to control carbon emissions. There have been Buddhist-centric publications on the subject [43-45], and a thorough examination of this topic is beyond the scope of this background paper.

Normally one might want to use the analogy of many drops needed to fill the bucket to illustrate how many people and organizations need to take action, however small the impact in the overall scheme of things, to help create solutions to the climate emergency.

Because we earlier used a bathtub being filled with carbon as an analogy for carbon going into the atmosphere (slowing the inflow alone will only delay the tub overflowing), perhaps a better analogy for cooperation on global warming is that many drops need to be removed from the tub.

We all need to contribute to removing as many drops as we can. Beyond our own direct contributions at Gomde UK, our aspiration is, to the best of our capacity, to influence other people and organizations to help stop that tub from overflowing.

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Endnotes

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[i] While this document is meant as a backgrounder for non-scientists, to provide credible backing on our perspectives we have included extensive scientific references. We recognize that most readers will not have access to academic libraries to access all reference documents (academic publishers often put research results behind paywalls). Whenever possible we have used open access sources and included hyperlinks in the bibliography; pdfs should be available free for most references, though a few are noted as being protected by publisher paywalls. You can always try to just google the article title for the paywalled papers – sometimes there are draft versions freely available for personal use from author's websites or university archives.

[ii] The Smithsonian Institute's paleoclimate climate timeline is available at: https://www.smithsonianmag.com/science-nature/paleoclimate-timeline/

[iii] For a brief non-technical synopsis, see Rebecca Lindsey's (2020), *Climate Change: Atmospheric Carbon Dioxide*, at the USA NOAA climate.gov website: https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide

[iv] For a general overview of current international initiatives for forest carbon sequestration, see the *Forest Carbon Partnership*: https://www.forestcarbonpartnership.org/

[v] On 19 May 2021 an article in the *Financial Times* reported that the market price in the UK's brand-new carbon trading market (which is very unlikely to reflect the true social cost) had hit £50 per mt: https://www.ft.com/content/56e02d3d-8c31-4937-be50-60d4bf9342f7

[vi] See https://interactive.carbonbrief.org/what-is-the-climate-impact-of-eating-meat-and-dairy/ for an accessible summary, and for more detail see the IPCC 18 summary findings https://www.ipcc.ch/srccl/chapter/chapter-5/

[vii] See article by Hannah Ritchie, 'Food waste is responsible for 6% of global greenhouse gas emissions' at https://ourworldindata.org/food-waste-emissions

[viii] See Emily Witt's article in *The New Yorker*: https://www.newyorker.com/magazine/2019/09/09/greta-thunbergs-slow-boat-to-new-york

[ix] See the UNFCCC webpage for information: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[x] Beef is, for instance, on a weight-for-weight basis about 3X and 10X as carbon intensive as cheese and carrots, respectively (for a simple fact sheet with numbers, see http://css.umich.edu/factsheets/carbon-footprint-factsheet)

[xi] This is still an approximation – the actual amounts may vary somewhat from this chart but we are confident that the general trends (and lessons to be drawn as a result) are justified.