ten in ten

The Gigatonne Strategy

10 in 10

THE GIGATONNE STRATEGY

How can we reduce global emissions
by one billion tonnes of CO_2e a year?

OPERATIONAL SPECIFICATIONS VERSION 2

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EXECUTIVE SUMMARY

DEMAND FOR URGENT CLIMATE ACTION IS GATHERING MOMENTUM. The recent shift in the public's perception of the seriousness of the climate crisis, driven partly by the mobilization of young people by Greta Thunberg, has led to increasing demand for immediate, effective action. In the UK, for example, a YouGov survey revealed that more than half the population supports total decarbonization of the economy by 2030, two decades ahead of the government's proposed timetable. This sense of urgency was recently reinforced by a stark warning endorsed by 11,000 scientists that the planet is "clearly and unequivocally" facing a climate emergency and immediate action is required to avoid "untold suffering"[1].

CLIMATE SCIENTISTS HAVE LONG BEEN CLEAR ABOUT *WHAT* NEEDS TO HAPPEN IF WE WANT TO AVOID DANGEROUS CLIMATE CHANGE. With emissions rising steadily and showing no sign of peaking[2], the scientific community is now telling us that pathways to limit global warming are getting significantly harder but are still possible: if we hope to stay within the carbon budget, we need a net reduction of emissions of at least 1 billion tonnes (a gigatonne) per year for the next 30 to 50 years[3].

AS CURRENT EFFORTS FALL SHORT, THE NEED FOR NEW STRATEGIC RESPONSES BECOMES APPARENT. Presently, the Paris Agreement represents our best strategy to curb emissions and limit global warming. However, the current level of political commitments under the Agreement puts us on a trajectory of 2.9°C to 3.4°C global temperature rise by the end of the century[4]. Such warming

1. William J Ripple, Christopher Wolf, Thomas M Newsome, Phoebe Barnard, William R Moomaw, "World Scientists' Warning of a Climate Emergency", *BioScience*, biz088 (November 2019), https://doi.org/10.1093/biosci/biz088

2. UNEP, *The Emissions Gap Report 2018* (Nairobi: United Nations Environment Programme, 2018), http://wedocs.unep.org/bitstream/handle/20.500.11822/26895/EGR2018_FullReport_EN.pdf

3. Rogeli et al., "Mitigation pathways compatible with 1.5°C in the context of sustainable development" in *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, ed. Masson-Delmotte et al. (in Press), https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf

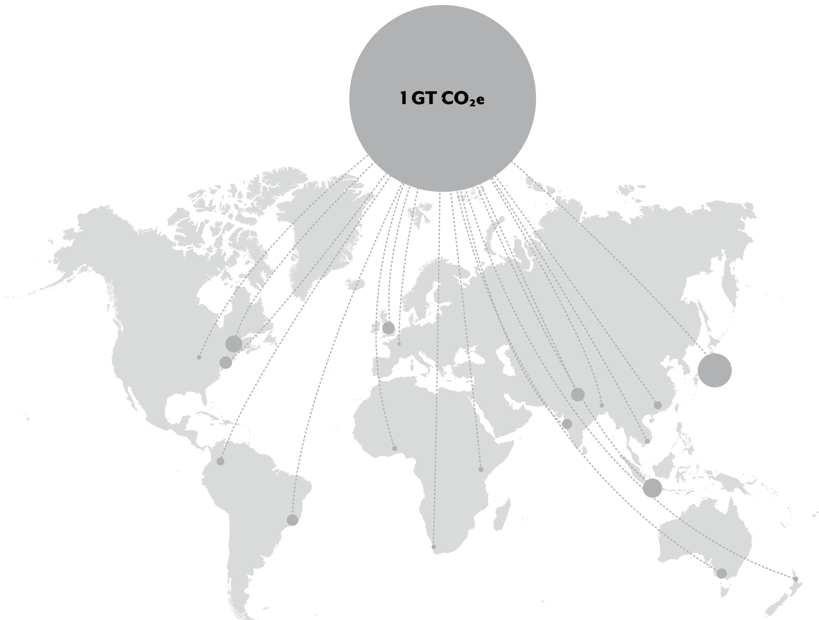
4. World Meteorological Organization (ed.), *United in Science* (UN Climate Action Summit, 2019), https://public.wmo.int/en/resources/united_in_science

carries a significant risk of triggering tipping cascades of ice sheet melting, circulation changes and biome loss that could turn the planet into an inhospitable place unable to accommodate more than 1 billion people[5].

5. Will Steffen et al., "Trajectories of the Earth System in the Anthropocene," *Proceedings of the National Academy of Sciences* 115, no 33 (Aug 2018): 8252-8259, https://doi.org/10.1073/pnas.1810141115

THE GIGATONNE STRATEGY IS AN ALTERNATIVE, BOLD, BOTTOM-UP RESPONSE TO THE CLIMATE CRISIS. It addresses the questions of ***how*** to reduce carbon emissions at the scale and pace required and ***who*** will deliver such reductions equitably. Our goal is to demonstrate in practice how to reduce global emissions by one gigatonne of CO_2e per year while engaging and benefiting those most affected by climate change.

SOLUTIONS WILL COME FROM TEAMS OF CITIZENS ACROSS THE WORLD. Diverse, multidisciplinary Gigatonne teams will test and implement practical, context-specific initiatives for reducing carbon emissions at scale, at speed and equitably, thus contributing to the global effort. The teams, which will be based in cities with over 1 million people, will work in six-month operational cycles, developing five energy-efficiency prototypes per cycle.



ABATING ONE GIGATONNE OF CO_2E PER YEAR REQUIRES THOUSANDS OF GIGATONNE TEAMS. One gigatonne equals roughly the annual emissions of 212 million passenger cars or the whole of the African continent. To obtain this level of emission abatement, we will need to mobilize thousands of teams across the globe and develop an infrastructure that allows them to operate in a decentralised way while ensuring the verifiability of their outputs.

OUR ROLE IS TO BUILD THE SOCIAL, OPERATIONAL AND FINANCIAL INFRASTRUCTURE OF THE GIGATONNE STRATEGY. A core element of the infrastructure is the ***Open Gigatonne Protocol***. It provides the operational requirements to become part of this strategic response, allowing Gigatonne Teams to be self-organised by the public sector, private sector or civil society. The Gigatonne Infrastructure will also include the ***process*** by which the teams deliver their prototypes, a ***reporting tool*** to collect, audit and share impact and performance data, and a ***Marketplace*** where teams can seek further funding once they meet the access requirements.

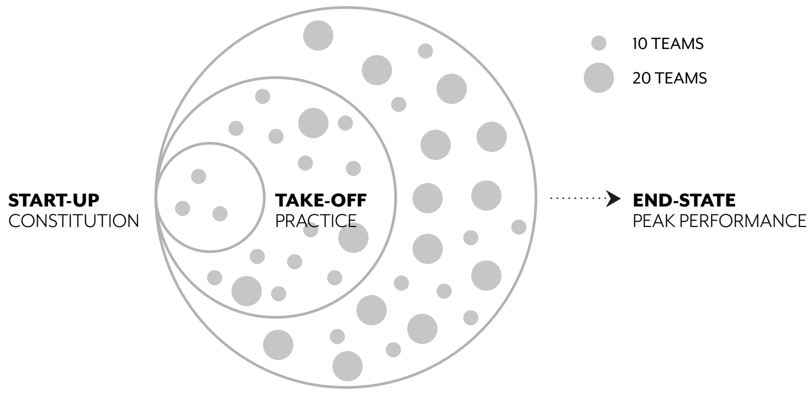
TEAMS ARE RESOURCED THROUGH A MIX OF FINANCIAL AND NON-FINANCIAL CAPITAL. Initially, teams will be financed through Gigatonne Seed Funds, geographic or sector-focused funds starting at USD$2.5-$20M (depending on geography), designed to support cohorts of five to 10 Gigatonne teams through two six-month operational cycles. After completing two cycles, teams will have access to 10x-100x more funding through the Marketplace. The teams will also benefit from non-financial investments from multiple stakeholders, in the form of skills and time (human capital), relationships (social capital), services and infrastructure (physical capital), data-sets, multiple forms of IP, and channels for data-dissemination (intellectual capital).

THE GIGATONNE STRATEGY CONSISTS OF THREE OVERLAPPING OPERATIONAL PHASES: START-UP, TAKE-OFF AND END-STATE. During the Start-Up Phase, we will test the strategy with up to 50 teams in different locations and develop the Gigatonne infrastructure. Funding for this phase will be provided by philanthropic partners and public funds.

During the Take-Off Phase, the number of teams will grow exponentially and the abatement target will increase substantially. Such growth is possible because teams will be using the Open Gigatonne Protocol to self-organise, secure initial funding and run the prototyping process. By this phase, we will focus on attracting more teams and expanding the infrastruture to accommodate the growing number of participants, which includes attracting substantial funding to the marketplace.

The goal of the strategy is to reach End-State, in which sufficient numbers of teams are making sufficient contributions towards a gigatonne goal that we can see global emissions declining.

Our technical assessment is that End-State could be achieved within 100 months. However, transitioning from one phase to the next requires a set of system conditions to be met and the speed at which that will occur is an unpredictable variable.



THE GIGATONNE STRATEGY ARISES FROM A DEEP UNDERSTANDING OF THE NATURE OF COMPLEX CHALLENGES. Our team has extensive experience across philanthropy, civil society, the private and public sectors. We are former CEOs, strategists, facilitators, researchers, project managers, and community organisers. We have managed multi-billion-dollar foundations and agile start-ups. We have deep sectoral expertise and wide networks of relationships to draw on. Some of us are grizzled and others are young. We are always learners and sometimes teachers.

Collectively, we have already supported many thousands of people in tackling complex challenges, from global food systems to youth unemployment, from overfishing to education. Meet our team in Appendix F - Who we are.

1. THE CHALLENGE

THIS DOCUMENT OUTLINES an operational specification for reaching a net greenhouse gas emissions reduction of 1 billion tonnes of CO2e[1] per year, thus contributing to keeping the global temperature rise well below 2°C in line with the Paris Agreement. We focus on answering the questions of 'how' to reduce global greenhouse gas emissions at the scale and pace required and 'who' will deliver such reductions equitably.

1. CO_2e, or carbon dioxide equivalent, is a standard unit for measuring carbon footprints. It expresses the impact of different greenhouse gases in terms of the amount of CO_2 that would create the same amount of warming.

1.1 THE STATE OF THE CLIMATE CRISIS

ACCORDING TO THE 'United in Science' report published in September by the Science Advisory Group of the UN Climate Action Summit 2019, the level of CO_2 concentration in the atmosphere will reach 410 parts per million by the end of the year[2]. Since 1992, when the United Nations Framework Convention on Climate Change (UNFCCC) was launched at the Rio Summit, CO_2e emissions have increased steadily from 34 Gt to 53.5 Gt in 2017 and show no sign of peaking[3].

2. World Meteorological Organization (ed.), *United in Science* (UN Climate Action Summit, 2019)

3. UNEP, *The Emissions Gap Report 2018* (Nairobi: United Nations Environment Programme, 2018)


CO_2e 409 PPM

CO_2e 53.5 GT

Fossil fuels continue to provide most of the world's energy, with oil, coal and gas emissions growing 1.2%, 1.4% and 5.3% in 2018.


OIL 12.8 GT

COAL 14.7 GT

GAS 7.6 GT

The climate impacts of atmospheric greenhouse gas levels are clear: the rise in global average temperature reached 1.1°C above pre-industrial levels in 2017 and is due to continue at a rate of 0.2°C per decade[4]. 2015-2019 will be the warmest five-year period on record, with the highest glacier mass loss. Due to the melting of ice sheets, sea-level rise is accelerating (4mm per year during 2007-2016, from 3.04mm per year in the previous decade). The world's climate and ecosystems are being hit harder and sooner than expected, and the risk of crossing critical tipping points is increasing.

4. Allen et al.,"Framing and Context" in *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, ed. Masson-Delmotte et al. (in Press), 81


TEMP +1.1°C

SEA LEVEL 94.5MM

In 2018, more than 16 million people had to leave their homes due to weather-related disasters, like typhoons, hurricanes, cyclones, floods and droughts[5]. By 2050, the number of climate refugees might reach between 25 million and 1 billion. The complex interplay between climate drivers of migration and societal responses makes this number all but unpredictable[6].

In September, an estimated 4 million people in 163 countries took part in the Global Climate Strike inspired by Greta Thunberg[7], launching a new cycle of global protest. Protesters are demanding action from governments and corporations, and are being met with vague reassurances and insufficient action.

The current level of political pledges to reduce emissions puts us on a trajectory of 2.9°C to 3.4°C global temperature rise by the end of the century. To meet the Paris target of 2°C, the scale and ambition of such efforts would need to triple[8].

Faced with the results of such inaction, public anger will continue to mount. The throng of protesters will swell. However, without a feasible set of operational proposals, such as those represented by the Gigatonne Strategy, protests demanding government or policy action will likely fail to generate significant change[9].

Effective action requires a different understanding of the nature of the climate challenge, one that accounts for its supranational nature and inherent complexity.

5. "The global displacement landscape," Global Report on Internal Displacement 2019, Internal Displacement Monitoring Centre, accessed September 2019, http://www.internal-displacement.org/global-report/grid2019/

6. Oli Brown, *Migration and Climate Change*, IOM Migration Research Series no 31, Switzerland: International Organization for Migration, 2008

7. Eliza Barclay and Brian Resnick, "How big was the global climate strike? 4 million people, activists estimate.," Vox, September 22, 2019, https://www.vox.com/energy-and-environment/2019/9/20/20876143/climate-strike-2019-september-20-crowd-estimate

8. World Meteorological Organization (ed.), *United in Science*

9. Micah White, *The end of protest: A new playbook for revolution* (New York: Knopf Canada, 2016).

1.2 THE NATURE OF THE CHALLENGE

THE NATURE OF the climate crisis as an underlying crisis of how society produces and consumes energy has long been known[10,11].

Despite this understanding being widely available, a "classic error"[12] continues to be made when attempting to address the climate crisis. From carbon pricing to carbon capture, all too often the climate crisis has been reduced to the technical problem of reducing global greenhouse gas emissions, as opposed to a

10. Ivan Illich, *Energy And Equity* (New York: Harper & Row,1974)

11. For one of the first accounts of the relation between coal and oil combustion and the concentration of CO_2 in the atmosphere, see Jack C. Pales and Charles David Keeling, "The Concentration of Atmospheric Carbon Dioxide in Hawaii," *Journal of Geophysical Research*. 70, no 24 (December 1965): 6053–6076, doi:10.1029/JZ070i024p06053.

complex adaptive challenge[13].

The underlying causes for this confusion relate to Business-As-Usual responses being historically disconnected from an understanding of complex systems.

Another way of stating this problem is that symptoms of the underlying challenges are confused with causes.

Recognising that the climate crisis is not simply a technical problem has profound operational implications. The primary implication is that the locus of the work sits with both experts and stakeholders and that the work requires learning.

PROBLEM[14]	**PROBLEM DEFINITION**	**SOLUTION DEFINITION**	**LOCUS OF WORK**
TECHNICAL	CLEAR	CLEAR	AUTHORITY
TECHNICAL & ADAPTIVE	CLEAR	REQUIRES LEARNING	AUTHORITY & STAKEHOLDERS
ADAPTIVE	REQUIRES LEARNING	REQUIRES LEARNING	STAKEHOLDERS

Charles David Keeling started the monitoring program at the Mauna Loa Observatory which has been recording the accumulation of CO_2 in the atmosphere since 1958 — as expressed in the Keeling Curve.

CO_2 409 PPMV

12. Ronald A. Heifetz, Marty Linsky, and Alexander Grashow, *The Practice of Adaptive Leadership: Tools and Tactics for Changing Your Organization and the World* (Boston, Mass.: Harvard Business Press, 2009)

13. Zaid Hassan, *The Social Labs Revolution* (San Francisco: Berret- Koehler, 2014)

14. Ronald A. Heifetz, Marty Linsky, and Alexander Grashow, *The Practice of Adaptive Leadership: Tools and Tactics for Changing Your Organization and the World* (Boston, Mass.: Harvard Business Press, 2009)

1.2.1 THE CHOICE OF A CARBON FRAMING

OUR CHOICE OF framing the challenge as an abatement challenge (one billion tonnes of CO_2e) is **a tactical choice**.

The real strategic challenge is redesigning society from one in which the natural systems are simply fuel for our machines to one in which we protect those ecosystems we depend on and are a part of [15,16].

One criticism of starting with a carbon framing, as opposed to say, a living planet framing, is the inherent reductionism that comes with it. We start to value, in other words, abstracted numbers instead of valuing parts of the living world that are necessary for a healthy planet.

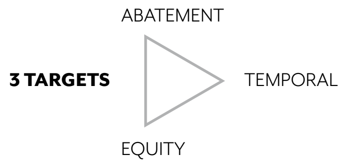
We recognise this as a valid risk. All attempts to change systems risk recreating the very dynamics that are causal drivers for the issues we are trying to tackle.

15. *"The point here is not that emissions don't matter. It is a call for a shift in priorities. On the policy level, we need to shift toward protecting and healing ecosystems on every level, especially the local. On a cultural level, we need to reintegrate human life with the rest of life, and bring ecological principles to bear on social healing. On the level of strategy and thought, we need to shift the narrative toward life, love, place, and participation. Even if we abandoned the emissions narrative, if we do these things emissions will surely fall as well."*
— **CHARLES EISENSTEIN** / CLIMATE: A NEW STORY

16. Zaid Hassan, "Notes on a Strategic Vacuum," October 19, 2011, `https://www.roller.sg/s/Notes-On-A-Strategic-Vacuum.pdf`

Our starting point however is a current reality where unfortunately the notion of a "living planet" is an abstraction for most people. Our journey is then from the current abstraction of carbon as a framing to the reality of what it means to live on a healthy planet.

1.2.2 THE THREE ELEMENTS OF THE CHALLENGE



WE SEE THE broader challenge of reducing global emissions as having three distinct targets.

The three targets — abatement, temporal and equity — can be thought of as three equations that must be tackled simultaneously.

Abatement target. Any operational response to the climate crisis must aim to reduce emissions at sufficient scale to impact planetary warming; this scale is gigatonnes of CO_2e. The science is saying [17] that, in order to hit a 66% probability of limiting global heating to 2°C by 2100, global CO_2e emissions must drop from the current level of 53.5 Gt to 40 Gt by 2030 and then to about 20 Gt by 2050. If aiming to limit warming to 1.5°C, CO_2e emissions need to drop to 24 Gt in the next 10 years and about 6 Gt in 2050. The goal we set for ourselves it to abate 1 gigatonne of CO_2e per year for the next decades.

17. UNEP, *The Emissions Gap Report* 2018, 20.

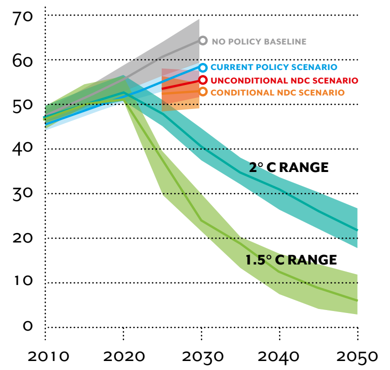


FIG 1. Global greenhouse gas emissions under different scenarios. UNEP Emissions Gap Report 2018 page XVIII : http://wedocs.unep.org/bitstream/handle/20.500.11822/26895/EGR2018_FullReport_EN.pdf?sequence=1&isAllowed=y

Temporal target. As emissions increase, the pathways to a solution get steeper and steeper. To stay within the 2°C scenario, emissions need to peak within the next 10 years[18] and decline at a constant rate of about 3.5 % per year until 2050[19]. If we fail to meet the temporal targets for peaking and annual gigatonne-scale reductions, the scientific consensus is that we will cross irreversible tipping points which risk catalysing runaway climate change.

18. Rogeli et al., "Mitigation pathways," 96.

19. UNEP, *The Emissions Gap Report* 2018, 8.

Equity target. The issue of equity in the context of the UNFCCC is notoriously contested. Arguably a lack of agreement on equity between historic emitters and emerging emitters resulted in the collapse of the Copenhagen negotiations in 2009.

Our approach to addressing the equity challenge is to start with the question of "who directly benefits from the success of the Gigatonne Strategy?".

If the answer to this question is that direct benefits accrue mainly to us, to corporations and to Western climate professionals then this represents a failure to meet the equity target.

Our answer to the question of who benefits is that those most profoundly impacted by the climate crisis must directly benefit from the success of the Gigatonne Strategy.

This is not simply an ethical question. Gigatonne-scale reductions are not possible without extensive investment of human and social capital from multiple stakeholders. This means that engagement and power-sharing arrangements of the Gigatonne Strategy are a vital component of ensuring success.

Flows of financial capital should therefore be directed to communities and stakeholders being impacted as a form of co-investment. If successful, the Gigatonne Strategy should be a key driver for the creation of livelihoods.

In our success scenarios we model our assumptions for equity impact. Our preferred success scenario would generate up to 200,000 jobs and engage over 2 million stakeholders.

Finally, we also recognise that the burden of emissions reductions cannot fall disproportionately on those most impacted by climate change.

While we see emissions reductions efforts taking place in countries like India and regions like sub-Saharan Africa, we intend to demonstrate what "common but differentiated responsibilities and respective capabilities"[(20)] means in practice.

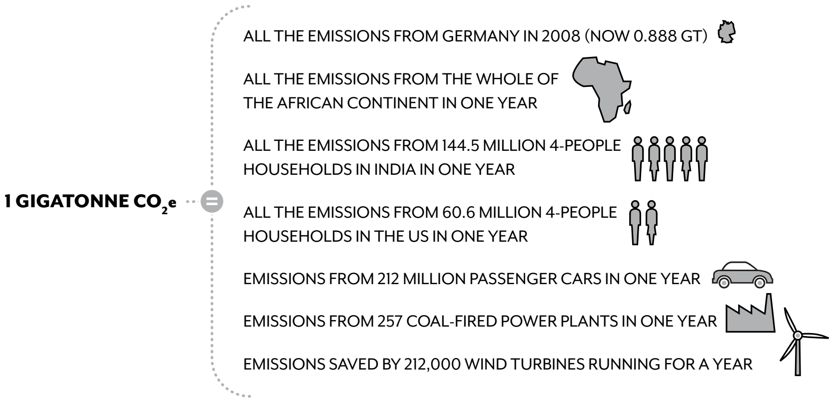
The strategy proposed here therefore aims to meet all three targets — abatement, temporal and equity — in line with the system conditions required to keep global temperature rise within the limits of the Paris Agreement.

20. The 1992 UNFCCC Treaty 1992 states that "the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions."

See Appendix A - System Conditions to Limit Warming to 1.5°C or 2°C.

1.3 WHAT IS A GIGATONNE OF CO_2e EMISSIONS?

HERE ARE SOME numbers[21] to give us a sense of what reducing emissions by a gigatonne (Gt) of CO_2e a year means.



21. Data sources: Global Carbon Atlas — http://www.globalcarbonatlas.org/en/ CO_2-emissions, United Nations Carbon Footprint Calculator — https://offset.climateneutralnow.org/footprintresult, and United States Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator — https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

2. THE GIGATONNE STRATEGY

The Gigatonne Strategy is a bold, bottom-up response[22] to the challenge of averting dangerous climate change.

Our goal is to demonstrate in practice how to reduce global emissions by one gigatonne of CO_2e per year while engaging and benefiting those most affected by the climate crisis.

This will be done through mobilizing and supporting teams across the world to implement practical, context-specific initiatives for reducing carbon emissions at speed, at scale, and equitably.

22. The origins of this strategy lie in a strategy formation exercise conducted for the Climate Action Network following the collapse of the climate negotiations in Copenhagen in 2009. See more in Zaid Hassan, "Taking Disappointment Seriously - Strategy & the Climate Action Network in a post-Copenhagen World", Reos Partners, 2010

2.1 THE GIGATONNE TEAMS

ONE GIGATONNE EQUALS roughly the annual emissions of 212 million passenger cars or the whole of the African continent. To obtain this level of emission abatement, we will need to mobilize thousands of teams across the globe, each making a measurable contribution towards a global effort.

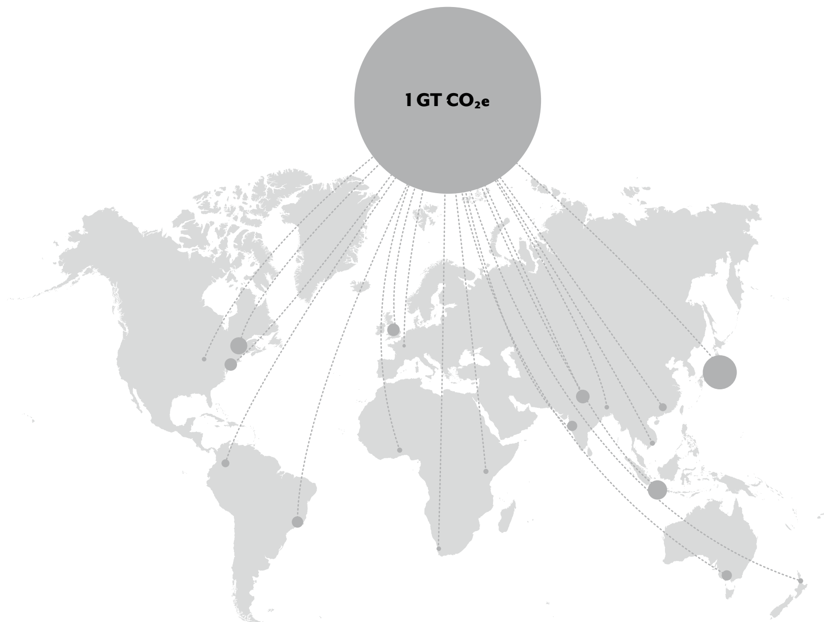


FIG 2. Illustrative contributions to a 1 GT target

2.1.1 WHO ARE THE GIGATONNE TEAMS?

GIGATONNE TEAMS WILL be made of diverse people drawn from diverse backgrounds, including people directly impacted by the challenge.

We will bring together people from indigenous wisdom traditions, engineering schools, the financial sector, government and grassroots communities, both urban and rural.

Participants are not required to form more networks or communities of practice. Neither will they be asked to gather at global conferences and profess their green credentials. Their challenge is to form disciplined teams able to work at the pace needed to deliver real results.

2.1.2 HOW WILL THE GIGATONNE TEAMS WORK?

GIGATONNE TEAMS ARE constituted in cohorts of five to 10 teams, each team consisting of approximately 45 people.

Each team will have a clear set of actions, an operating agreement and a budget, and will be required to test and implement five emission-reduction 'prototypes' per six-month cycle.

Prototypes will have to meet minimum abatement criteria. For example, a prototype might be required to reduce emissions by 4,000 tonnes of CO2e. This is the equivalent of greenhouse gas emissions from 850 passenger vehicles driven for a year or emissions avoided by 1,400 tonnes of waste recycled instead of landfilled.

The larger the number of participating teams, the lower (and more feasible) the abatement each team needs to contribute to the global 1 gigatonne goal.

Prototypes will also have equity criteria, in that their implementation must benefit local communities.

2.2 THE GIGATONNE INFRASTRUCTURE

GIVEN THE NUMBER of teams required to deliver gigatonne-scale results, it is impractical to centralise the forming, funding and running of such teams. Consequently, our role is to build the social, operational and financial infrastructure to allow teams to self-form and operate in an autonomous and decentralised way.

A core element of the infrastructure is the Open Gigatonne Protocol. It provides the operational requirements to become part of this strategic response, allowing Gigatonne Teams to be self-organised by the public sector, private sector or civil society.

The Gigatonne Infrastructure includes also:

- the **iterative process** by which the teams deliver their prototypes
- a **reporting tool** to collect, audit and share impact and performance data
- a **Marketplace** where teams can seek further funding once they meet the access requirements
- an **Open Innovation Pipeline**, which provides ideas for prototypes.

The following sections describe the operationalisation of the Gigatonne Strategy.

3. OPERATIONALIZING THE GIGATONNE STRATEGY

3.1 CORE ASSUMPTIONS OF THE GIGATONNE STRATEGY

TWO CORE ASSUMPTIONS underlie the Gigatonne Strategy.

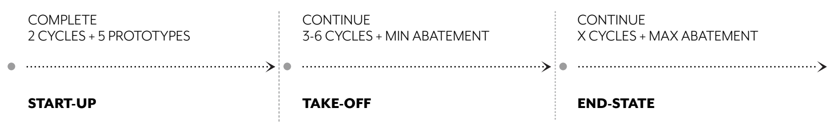
Teams will require time to reach 'peak performance'. The Gigatonne Strategy therefore consists of three overlapping operational phases: **Start-Up**, **Take-Off** and **End-State**. The goal is to reach End-State, in which sufficient numbers of teams are making sufficient contributions towards a gigatonne goal that we can see global emissions declining.

It is practically impossible (and undesirable from an equity perspective) to abate a billion tonnes of CO2e from a single geography. Therefore, we will be constituting and operationalising distributed teams across the world, each committed to a measurable contribution towards a one gigatonne target.

Below we discuss how the teams will reach 'peak performance' and how we will build a network of distributed teams.

3.2 REACHING PEAK PERFORMANCE

THE TEAMS WILL work in six-month operational cycles, developing 5 emission-reducing prototypes per cycle. We expect the level of CO2e emissions abatement delivered by each team to be lower initially and increase gradually.



3.2.1 PHASE 1 / GIGATONNE START-UP

THE START-UP PHASE involves launching the Gigatonne Strategy with between 1-5 cohorts, each cohort consisting of 5 to 10 teams.

During the Start-Up Phase, we will be directly involved in setting up national "Gigatonne Funds" to support the teams. We anticipate setting up to three Gigatonne Funds as demonstrations during this phase.

Each of these teams will be supported to run 2 six-month operational cycles and test up to 10 prototypes, of which 5 are expected to succeed.. During this phase, prototypes are expected to provide up to 4,000 tonnes of CO2e emissions reduction.

Some examples of prototypes at this stage are:

EXAMPLES OF START-UP PROTOTYPES	GHG EMISSION REDUCTION	SOURCE
REPLACING 38,000 INCANDESCENT LAMPS WITH LEDS	1,000 TONNES OF CO_2e	UNITED STATES ENVIRON. PROTECTION AGENCY[23]
INSULATING 58,800 LOFTS IN UK	4,000 TONNES OF CO_2e	COMMITTEE ON CLIMATE CHANGE (UK)[24]

23. Source: EPA's Greenhouse Gas Equivalencies Calculator - https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

24. Committee on Climate Change, "Reducing emissions from buildings," In *Fourth Carbon Budget Review — technical report | Sectoral analysis of the cost-effective path to the 2050 target.* (2013), 65

Please note that, while prototypes might involve new applications of existing technology, they do not necessarily require technological innovation.

3.2.2 PHASE 2 / GIGATONNE TAKE-OFF

THE GIGATONNE END-STATE is preceded by a period we refer to as Gigatonne Take-Off, in which the conditions to achieve the Gigatonne End-State are put in place.

During this phase, teams are expected to deliver 4,000 to 20,000 tonnes of CO2e reduction per prototype.

EXAMPLES OF START-UP PROTOTYPES	GHG EMISSION REDUCTION	SOURCE
INSTALLING ELECTRICITY METERS AND RETROFITTING CORPORATE FACILITIES	16,800 TONNES OF CO_2e	CORPORATE INITIATIVE BY INFOSYS (INDIA)[25]
INSTALLING SMART THERMOSTATS IN 5,400 INTERNET-ENABLED HOMES	20,000 TONNES OF CO_2e	DRAWDOWN PROJECT[26]

25. CDP, *Energy Efficiency Bears Fruits For India Inc.*, 2015, 22

26. "Smart thermostats," Solutions, Project Drawdown, https://www.drawdown.org/solutions/buildings-and-cities/smart-thermostats

3.2.3 PHASE 3 - GIGATONNE END-STATE

THE GOAL OF this strategy is to establish a Gigatonne End-State in which the necessary number of Gigatonne Teams are deployed and able to collectively reduce global emissions at the rate of 1 gigatonne of CO_2e every year.

The core operating principle informing our strategy is:

THE MORE TEAMS CONTRIBUTING = THE LOWER THE TARGET PER TEAM

One way of imagining the Gigatonne End-State is as a number of teams (estimated at between 1,000 to 5,000) running a diverse range of prototypes (Alpha Prototypes = 200KT CO_2e to Epsilon Prototypes = 40 KT CO_2e) that add up to abating 1 gigatonne of CO_2e per year.

See Section 3.4.3.1.1 on Prototype requirements.

EXAMPLES OF END-STATEPROTOTYPES	GHG EMISSION REDUCTION	SOURCE
IMPLEMENTING NEW SODA ASH MANUFACTURING PROCESS	77,000 TONNES OF CO_2e	CORPORATE INITIATIVE BY TATA CHEMICALS (INDIA)[27]
INSTALLING HEAT PUMPS INTO 57,000 HOMES	200,000 TONNES OF CO_2e	COMMITTEE ON CLIMATE CHANGE (UK)[28]

27. CDP, Energy Efficiency Bears Fruits For India Inc., 19

28. Committee on Climate Change, "Reducing emissions from buildings," 59

We envision establishing a Gigatonne End-State through creating an **Open Gigatonne Protocol** that allows Gigatonne Teams to be self-organised by either the public sector, private sector or civil society.

3.2.4 REQUIREMENTS TO MOVE FROM ONE PHASE TO THE NEXT

EACH OF THESE phases will be 'complete' when a series of minimum operational requirements are met (as opposed to shifting to a new phase as per a preset timetable).

The requirements to shift from **Start-Up Phase To Take-Off Phase** include:

REQUIREMENT 1	20 TO 30 TEAMS OPERATIONAL
REQUIREMENT 2	LAUNCH OF OPEN GIGATONNE PROTOCOL VERSION 1.0
REQUIREMENT 3	LAUNCH OF MARKETPLACE (*see Section on Resources*)

The requirements to shift from **Take-Off Phase to End-State Phase** include:

REQUIREMENT 4	SUFFICIENT MARKETPLACE CAPITALISATION (*see Section on Resources*)
REQUIREMENT 5	SUFFICIENT NUMBERS OF TEAMS "LIVE" TO PROVIDE PERFORMANCE DATA (*see Section on Measurement*)
REQUIREMENT 6	OPEN GIGATONNE PROTOCOL FORMALIZED

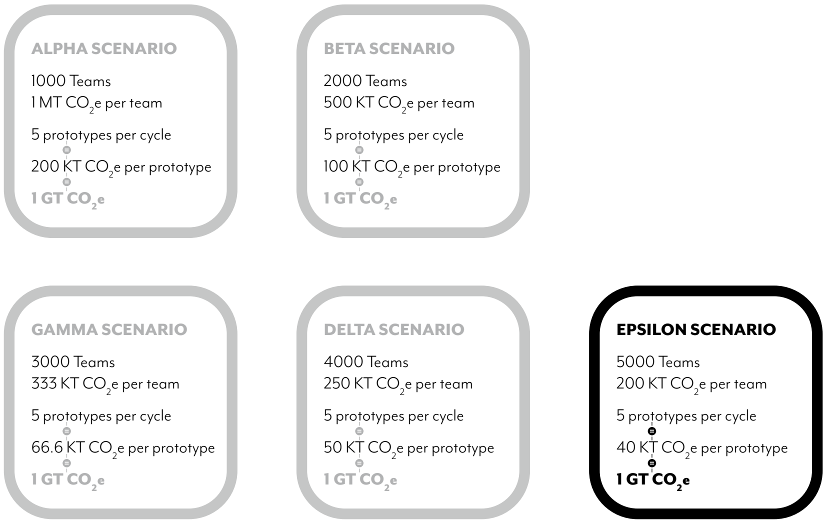
Our technical assessment is that End-State could be achieved within 100 months. However, transitioning from one phase to the next requires a set of operational requirements to be met and the speed at which that will occur is an unpredictable variable.

3.3 BUILDING A NETWORK OF DISTRIBUTED GIGATONNE TEAMS

TO ACHIEVE THE scale and speed of CO_2e emissions abatement required, we will aim to build a network of thousands of distributed teams. As the number of teams increases, the abatement target of each team (i.e., their contribution to the 1 gigatonne goal) decreases, making it more feasible.

3.3.1 SUCCESS SCENARIOS FOR DIFFERENT NUMBERS OF TEAMS

We have created five theoretical success scenario models, Alpha, Beta, Gamma, Delta, and Epsilon, each a function of the total number of teams engaged in the shared goal of reducing a gigatonne of CO_2e.



These scenarios are heuristics informing operational modelling and decision making.

Each scenario gives us a sense of what the operational challenges would be per team, with targets obviously declining with an increase in the total number of teams that are operational and signed up to a collective gigatonne target.

In an Alpha Scenario, there are 1,000 teams distributed across the world; each team would need to deliver on an abatement target of 1 MT CO_2e, which when divided into 5 prototypes is 200 KT CO_2e per prototype (we assume that each team will produce 10 prototypes per year, of which 50% will be successful; this assumption will be adjusted as the number of teams increases and we are able to develop a probability model based on real-world data). In an Epsilon Scenario, with 5,000 teams, each team would have an abatement target of 200 KT CO_2e, which when divided into 5 prototypes is 40 KT CO_2e per prototype.

Scenarios with larger numbers of teams are more strategically difficult but more tactically feasible and, in our opinion, more desirable.

We use Epsilon Scenario (5,000 teams) as a baseline scenario because it has the following advantages:

1. Lowest abatement target per team and per prototype
2. More contextually-specific solutions due to greater decentralisation
3. Highest equity impact due to the larger number of engaged stakeholders
4. Allows for the creation of a distributed local-to-global data feedback loop due to higher number of local data sources
5. Allows for creation of a real-world probability model due to the greater variation in performance, contextual variation and failure rates

3.3.2 GROWTH PATHWAYS TO END-STATE

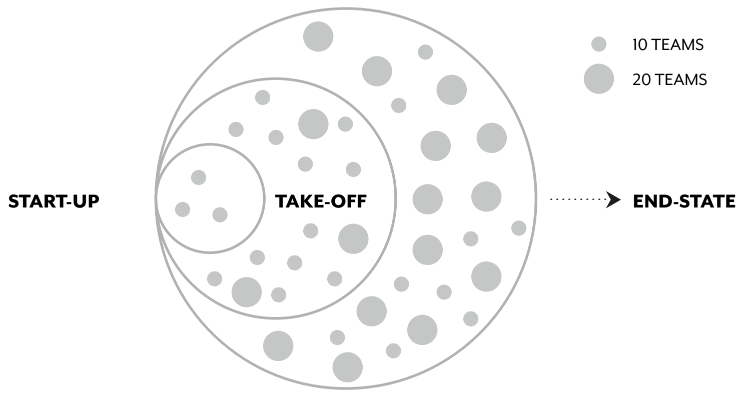


FIG 3. Growth pathways from Start-Up to End-State Phase

FOR THE GIGATONNE Strategy to succeed, the total number of teams will need to grow at exponential rates. If growth is dependent on high transaction costs then, at best, the number of teams will grow linearly, resulting in insufficient teams to reach End-State. Instead we have designed the infrastructure to accommodate and foster exponential growth.

Using both financial and non-financial mechanisms, we will incentivize each initial team to generate new teams, for example to apply successful prototypes in different contexts. The growth rates for teams to spawn new teams to be unpredictable and organic.

See Appendix B - Collaborative by Design.

The example below shows a possible scenario in which one in five prototypes leads to the formation of a new team.

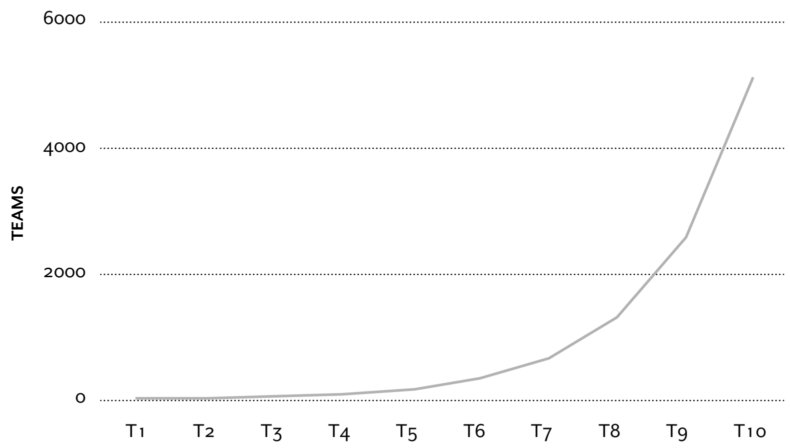


FIG 4. Team Growth Model for 20% spin-off rate

Additionally, the Gigatonne Strategy is designed to grow at **near zero marginal cost**, allowing the number of on-the-ground teams to expand without a proportional increase in centralised operational costs.

The **Open Gigatonne Protocol** will provide potential teams with the operational requirements to become part of this strategic response, including critically, the requirements to access financial resources via the Marketplace.

Teams that meet the requirements set out in the Open Gigatonne Protocol can then apply to be listed on the **Marketplace**, where they can access 10x-100x more financial resources than Seed Funds. We will fast-track the process for listing through automating, and where appropriate, outsourcing functions.

New cohorts of teams are expected to self-organize and self-fund during the first two operational cycles, before gaining access to the Marketplace where they can obtain further funding.

We envision the Open Gigatonne Protocol to provide a route to operationalising emission reduction pledges for cities, regions, and countries, as well as for institutions and sectors.

3.4 THE GIGATONNE OPERATIONAL EQUATION

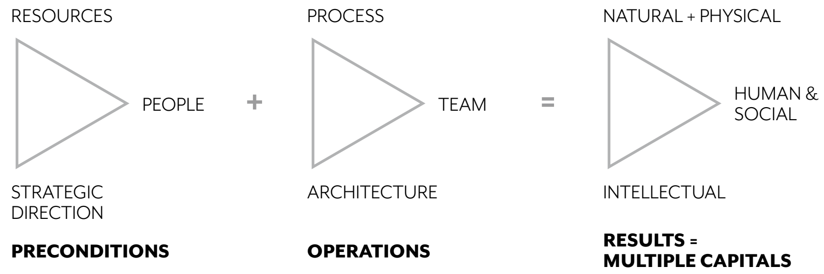


FIG 5. Team Growth Model for 20% spin-off rate

THE GIGATONNE STRATEGY is built on an operational "equation" consisting of the following elements:

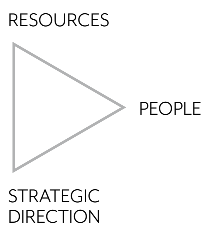
Preconditions for Action + Operational Elements = Results in the form of multiple capitals.

Preconditions for Action include an agreement on the ***challenge***, coupled with three requirements: the right ***resources***, the right ***people*** and an agreement on ***strategic direction***.

Operational Elements include the constitution of multi-stakeholder ***teams*** engaged in an innovation ***process*** that results in the creation of operational prototypes designed to abate greenhouse gases. Teams are supported by an operational ***architecture***.

Resources (both as inputs and outputs) are measured in the form of multiple capitals: ***Financial, Intellectual, Human, Social, Physical and Natural***.

3.4.1 PRECONDITIONS FOR ACTION



PRECONDITIONS CAN BE seen as the prerequisite phase where the conditions for strategic action are put into place. A simple way of understanding Preconditions is getting the right inputs into place.

The ideas, people, power structures, institutions, and relationships that constitute the founding moments of a strategy will often determine its success or failure.

All too often, preconditions are incomplete which results in false starts and inadequate organizational setups.

The work of putting preconditions in place has both an internal and external focus. The internal involves building healthy relationships between participating stakeholders while the external is about establishing the most effective conditions for strategy as action.

The external includes:

1. Agreement on the Challenge
2. Putting in place Resources (financial, political and social) commensurate with the scale of the challenge
3. Finding the People required to credibly mount a strategic response
4. Determining the Strategic Direction of the effort.

3.4.1.1 CHALLENGE

OUR INITIAL STRATEGIC challenge is defined as reducing global emissions by one gigatonne of CO_2e. The specific challenge per team varies between Start-Up, Take-Off and End-State Phases as follows (assuming a 50% success rate for prototypes):

START-UP PHASE
10-50 TEAMS
5-20 Kt CO_2e ABATEMENT PER TEAM
1-4 Kt PER PROTOTYPE

ALPHA SCENARIO	BETA SCENARIO	GAMMA SCENARIO	DELTA SCENARIO	EPSILON SCENARIO
1,000 TEAMS	2,000 TEAMS	3,000 TEAMS	4,000 TEAMS	5,000 TEAMS

TAKE-OFF PHASE

100 Kt CO_2e ABATEMENT PER TEAM	50 Kt CO_2e ABATEMENT PER TEAM	33 Kt CO_2e ABATEMENT PER TEAM	25 Kt CO_2e ABATEMENT PER TEAM	20 Kt CO_2e ABATEMENT PER TEAM
20 Kt PER PROTOTYPE	10 Kt PER PROTOTYPE	6.6 Kt PER PROTOTYPE	5 Kt PER PROTOTYPE	4 Kt PER PROTOTYPE

END-STATE PHASE

1 Mt CO_2e PER TEAM	500 Kt CO_2e PER TEAM	333 Kt CO_2e PER TEAM	250 Kt CO_2e PER TEAM	200 Kt CO_2e PER TEAM
200 Kt PER PROTOTYPE	100 Kt PER PROTOTYPE	66.6 Kt PER PROTOTYPE	50 Kt PER PROTOTYPE	40 Kt PER PROTOTYPE

3.4.1.2 RESOURCES

ONE OF THE most common challenges with addressing complex social challenges is that strategies are consistently financially under-resourced. Effective strategic responses require the resource available to be commensurate with the results desired.

Our approach to ensuring adequate resources are in place is to see inputs in terms of hybrid capital, not simply financial capital.

See Section 3.5 for our resource strategy, including hybrid capital input models.

3.4.1.3 PEOPLE

A KEY CRITERIA for the success of the Gigatonne Strategy is the participation of socially diverse actors.

Multi-disciplinary teams are typically horizontally diverse, with actors usually being characterised by "white collar diversity."

We are seeking participation that is both horizontally diverse and vertically diverse, in that people will come from multiple levels of the system, from community members to senior politicians.

While ensuring that multiple parts of a system are represented, we are looking for more than representation. We are also looking for "skin-in-the-game," that is people who are impacted directly by the situation.

See Section 3.4.2.1 for more details about the constitution of Gigatonne Teams.

3.4.1.4 STRATEGIC DIRECTION

RESPONDING STRATEGICALLY TO complex social challenges requires making a choice in direction. Strategic direction can be thought of as a subset of all possible solutions[29].

For the Start-Up Phase of the Gigatonne Strategy we have decided to focus on energy efficiency and a geographic focus on cities. As we move into Take-Off and End-State Phases, we envision launching multiple Seed Funds focusing on other potential strategic directions, such as carbon sequestration in agricultural land or hydrogen as a low-carbon complementary solution to energy efficiency and electrification[30].

29. Project Drawdown can be thought of as a compilation of potential strategic directions offering vast abatement potential.

REFRIGERANT MANAGEMENT	89.74 GT CO_2e
REDUCED FOOD WASTE	70.53 GT CO_2e
ELECTRIC WEHICLES TRANSPORT	10.8 GT CO_2e
INSULATION	8.27 GT CO_2e
LED LIGHTING (HOUSEHOLD)	7.81 GT CO_2e
HEAT PUMPS	5.20 GT CO_2e
HOUSEHOLD RECYCLING	2.77 GT CO_2e
INDUSTRIAL RECYCLING	2.77 GT CO_2e
RIDESHARING	0.32 GT CO_2e

30. Committee on Climate Change, Hydrogen in a Low-Carbon Economy, 2018, 20

ENERGY EFFICIENCY + GEOGRAPHIC FOCUS ON CITIES

We picked **Energy Efficiency** as our strategic direction for two main reasons:

CONSENSUS FOR EMISSION REDUCTION POTENTIAL — according to the EIA's latest World Energy Outlook scenario, energy efficiency will contribute over 40% of the carbon emissions reductions required to be in line with Paris targets[31]. Despite having offset fewer carbon emissions in 2018 than in 2017 due to a slowdown on policy implementation, energy efficiency continues to be the largest source of emissions abatement; with only one-third of energy use currently covered by energy efficiency policies, there is a clear opportunity to improve on the 0.273 Gt of CO_2 abatement recorded in 2018[32].

EASE AND SPEED OF PROTOTYPING — both the IEA and the UNEP highlight that the technologies required to deliver these vast emission reductions are already widely available; by offering plenty of opportunities for significant impact without the need for technological innovation, this focus on energy efficiency will allow the Gigatonne Teams to prototype initiatives at the pace and scale required.

We have a strategic focus on **Cities**[33] because they provide:

VAST OPPORTUNITIES FOR EMISSION ABATEMENT — cities contain 55% of

31. Ritchie et al., *Energy Efficiency 2018: Analysis and outlooks to 2040* (Paris: OECD/ International Energy Agency, 2018), 25

32. "Efficiency." Global Energy & CO_2 Status Report. International Energy Agency, accessed September 2019, `https://www.iea.org/geco/efficiency/`

"Energy efficiency, sometimes called "conservation", is also known as the "fifth fuel". For decades, its significance was underestimated and its role debated, sometimes dismissively so. But today, energy efficiency has moved from contention to consensus. [...]The basic challenge to energy efficiency is the same around the world. Energy efficiency is not one big thing. It is embodied in everything — buildings that operate more cleverly, cars that get more miles to the gallon, factories that put in new technologies and reduce energy use in manufacturing goods — and, yes, planes, that get better mileage in the skies." — **DANIEL YERGIN** / ENERGY EFFICIENCY: THE NEW "FIRST FUEL"

33. Data on city-based initiatives from Falk et al., *Exponential Roadmap 1.5* (Sweden: Future Earth, 2019), 116-124

the world's population but produce 70% of CO_2 emissions; as some cities have emission levels larger than countries, successful local abatement initiatives could have a significant impact. Urban transport systems, buildings, construction, and industry offer opportunities for energy efficiency initiatives and can deliver much of the abatement we seek(34). Urban dwellers have the expertise to drive innovation and show a level of support for climate action that makes it a safe bet for politicians.

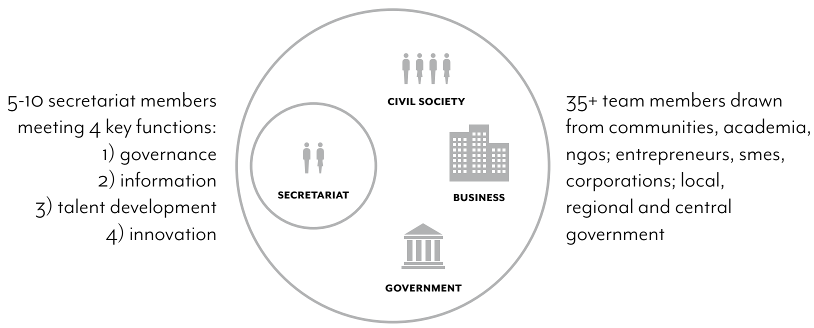
34. World Meteorological Organization (ed.), *United in Science*

See Appendix G for some examples of cities that meet the criteria to host Gigatonne Teams.

HISTORICAL CLIMATE LEADERSHIP — city governments have been on the forefront of climate action with low-carbon policies and initiatives like C40's Deadline 2020, Carbon Neutral Cities Alliance and Carbon Disclosure Project A-list; by 2017 more than 7,000 cities from 133 countries, representing 16.9% of the global population, had pledged action on climate change.

3.4.2 OPERATIONAL ELEMENTS

3.4.2.1 GIGATONNE TEAMS



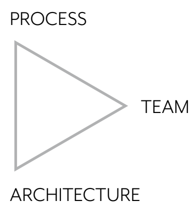


FIG 6. Anatomy of a Gigatonne team: 40-45 people

GIGATONNE TEAMS ARE constituted in cohorts of 5 to 10 teams at a time. Teams are geographically proximate to each other (countries, regions or cities).

Each Team consists of approximately 45 people. Between 5 to 10 people constitute a Secretariat, whose role is to provide four key functions (1) Governance (2) Information (3) Capacity development and (4) Innovation.

See Section 3.4.2.3 Architecture for more information.

Each Gigatonne Team is constituted by a "convening" team. This team could technically be the same as the Secretariat or it could be distinct.

Joining the Gigatonne Lab is a competitive application process. Applications are submitted by teams (formal or informal) that elect to serve as both the Convenor and Secretariat or just the Convenor (which means appointing a Secretariat).

Each Gigatonne Team ultimately consists of stakeholders drawn from Communities, Academia, NGOs; Entrepreneurs, SMEs, Corporations; Local, regional & central government.

3.4.2.2 PROCESS: OPERATIONAL CYCLES

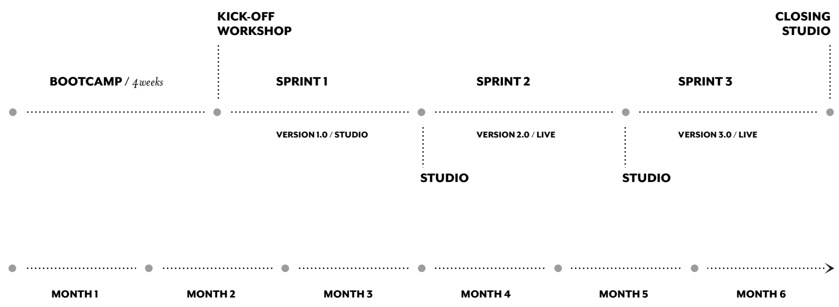


FIG 7. Timeline and structure of an operational cycle

A SINGLE OPERATIONAL Cycle is 6 months in length, during which Team will develop and test a series of prototype solutions to CO_2e abatement.

Each team has a clear set of actions, an operating agreement and a budget. They work over the period, reporting and documenting their progress with an aim of iterating and improving their prototypes as they move forward.

Teams are provided with funding to test and implement their prototypes. The funding needs are likely to increase with each cycle, as the CO_2e abatement goals increase as well.

During each Operational Cycle there are several gathering points or **Studios** where all members of a Gigatonne Team come together to share and iterate their prototypes. The period in between these gatherings is called a **Sprint**.

At the end of each studio/start of each sprint, tasks are agreed for each team, providing a clear focus for the next sprint period. At the end of the sprint, the teams review their progress and learning and then starts the next sprint, repeating the process.

The Gigatonne Strategy uses an agile project management process. Borrowing from complex software development, agile project management is a flexible methodology suited to operating in situations of complexity and emergence. This methodology is iterative and allows for emergent tasks — ensuring that teams are able to meet the shifting nature of the challenge they are working on.

See Appendix C. Anatomy of an Operational Cycle.

3.4.2.3 ARCHITECTURE

THE ARCHITECTURE SUPPORTING each Gigatonne Cohort can be thought of in terms of 4 "stacks" or specialized functions (for example, a traditional organisation will have functions like "Marketing" or "HR").

STACKS	KEY STRUCTURAL ELEMENTS
GOVERNANCE HOW ARE DECISIONS MADE?	OPEN GIGATONNE PROTOCOL TEAM SECRETARIAT FIDUCIARY RESPONSIBILITIES INTERFACE WITH MARKETPLACE
INFORMATION HOW IS INFORMATION PRODUCED, INTERPRETED, STORED AND SHARED?	MULTIPLE CAPITAL RETURNS – CROI REPORTING FRAMEWORK REAL-TIME DATA SHARING OPEN INNOVATION PIPELINE
CAPACITY HOW ARE DEVELOPED THE SKILLS NEEDED TO ADDRESS COMPLEX CHALLENGES?	COMPLEXITY U GIGATONNE BOOTCAMPS CONVENING FUNCTION
INNOVATION HOW ARE PROTOTYPES CREATED AND TESTED?	PROTOTYPING OPERATIONAL CYCLES (AGILE) TEAM FACILITATION

3.4.2.3.1 INNOVATION

The Innovation Stack is designed to support the Operational Cycles which generate prototypes. This includes functions such as facilitation, conflict resolution, as well as practical issues such as logistics and administration.

3.4.2.3.2 CAPACITY

The Capacity Stack is designed to ensure that Teams have the right capacities to deliver the work. This will range from helping to convene Gigatonne Teams, through to recruitment of specific skills required by the team through to actual training and capacity building. All Teams accepted will go through a 4-week residential "Gigatonne Bootcamp" where they will be inducted into the work.

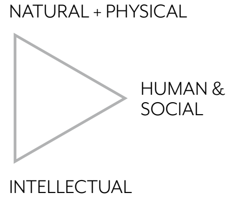
3.4.2.3.3 INFORMATION

The purpose of Information Stack is manage data flows including (1) Communicating up and down (to shareholders "above" and "below" us) (2) Communicating "across" to other Teams and (3) Ensuring that a quarterly CROI report is submitted. In practical terms this will involve creating and managing an archive from which various information products can be created.

3.4.2.3.4 GOVERNANCE

The Governance Stack focuses on ensuring key decisions, around for example participation, fiduciary issues and more, are conducted in an accountable way. While the specific features of governance will vary depending on context, we will provide the Teams with a clear set of accountabilities, for example ensuring a quarterly CROI report is submitted. We will also provide support when needed.

3.4.3 RESULTS



3.4.3.1 PROTOTYPES (NATURAL CAPITAL + PHYSICAL CAPITAL)

A PROTOTYPE IS an experiment in attempting to reduce emissions. Our prototypes will focus on energy efficiency. While they may involve new applications of existing technology, for example new grid-management technology, they do not necessarily require technological innovation.

Teams will 'stress test' each prototype for technical, financial, social and political feasibility during 30 days. If a prototype survives the stress test, implementation begins immediately. Within a 6-month operational cycle, each prototype goes through three implementation sprints, each building on a Version 1.0 (which can be thought of as a minimal viable product).

At the end of a 6-month cycle, a prototype will either:

1. continue to the next operational cycle (Version 2.0)
2. fork, i.e. become two different prototypes
3. pivot
4. end.

3.4.3.1.1 PROTOTYPE REQUIREMENTS

TEAMS ARE REQUIRED to design and implement prototypes with minimum emission reduction criteria, which vary according to phase (Start-Up, Take-Off or End-State) and the number of active teams at any time.

During the Start-Up Phase, the teams are expected to generate between 5Kt and 20 Kt of CO_2e emission reductions, which translates into into 1 -4 Kt per prototype. During the Take-Off phase, the required level of CO_2e reduction will be 4-20 Kt per prototype, in order to meet our goal of 100 Kt per team. When the teams enter the End-State phase, the goal per team will increase to 1000 Kt (or 1 Mt), pushing the required level of CO_2e reduction to 40-200 Kt per prototype. These figures assume that 5 out of 10 prototypes created per year are successful.

These numbers are heuristics guiding action. We envision once we are in Take-Off and End-State, a feedback loop with live-data streaming from Teams globally will create a more dynamic picture of emissions criteria per prototype.

We anticipate that Teams will achieve End-State capacity once they have run several operational cycles while managing to implement prototypes at price-points that allow for mass roll-out.

35. Source: EPA's Greenhouse Gas Equivalencies Calculator — https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

	START-UP PHASE		TAKE-OFF PHASE		END-STATE PHASE	
	PER PROTOTYPE REQUIREMENT	EQUIVALENT TO[35]	PER PROTOTYPE REQUIREMENT	EQUIVALENT TO	PER PROTOTYPE REQUIREMENT	EQUIVALENT TO
ALPHA PROTOTYPE (MAX)	4,000 TONNES OF CO_2e PER YEAR	GREENHOUSE GAS EMISSIONS FROM 850 PASSENGER VEHICLES DRIVEN FOR A YEAR GREENHOUSE GAS EMISSIONS AVOIDED BY 1396 TONNES OF WASTE RECYCLED INSTEAD OF LAND FILLED	20,000 TONNES OF CO_2e PER YEAR	GREENHOUSE GAS EMISSIONS FROM 4246 PASSENGER VEHICLES DRIVEN FOR A YEAR GREENHOUSE GAS EMISSIONS AVOIDED BY 6976 TONNES OF WASTE RECYCLED INSTEAD OF LAND FILLED	200,000 TONNES OF CO_2e PER YEAR	GREENHOUSE GAS EMISSIONS FROM 42,463 PASSENGER VEHICLES DRIVEN FOR A YEAR GREENHOUSE GAS EMISSIONS AVOIDED BY 69,759 TONNES OF WASTE RECYCLED INSTEAD OF LAND FILLED 42.4 WIND TURBINES OPERATING FOR A YEAR

	START-UP PHASE		TAKE-OFF PHASE		END-STATE PHASE	
	PER PROTOTYPE REQUIREMENT	EQUIVALENT TO[35]	PER PROTOTYPE REQUIREMENT	EQUIVALENT TO	PER PROTOTYPE REQUIREMENT	EQUIVALENT TO
EPSILON PROTOTYPE (MIN)	1,000 TONNES OF CO_2e PER YEAR	GREENHOUSE GAS EMISSIONS FROM 213 PASSENGER VEHICLES DRIVEN FOR A YEAR GREENHOUSE GAS EMISSIONS AVOIDED BY 349 TONNES OF WASTE RECYCLED INSTEAD OF LAND FILLED	4,000 TONNES OF CO_2e	GREENHOUSE GAS EMISSIONS FROM 849 PASSENGER VEHICLES DRIVEN FOR A YEAR GREENHOUSE GAS EMISSIONS AVOIDED BY 1,395 TONNES OF WASTE RECYCLED INSTEAD OF LAND FILLED	40,000 TONNES OF CO_2e (OR 40 Kt CO_2e) PER YEAR	GREENHOUSE GAS EMISSIONS FROM 8,493 PASSENGER VEHICLES DRIVEN FOR A YEAR GREENHOUSE GAS EMISSIONS AVOIDED BY 13,952 TONNES OF WASTE RECYCLED INSTEAD OF LAND FILLED 8.5 WIND TURBINES OPERATING FOR A YEAR

3.4.3.1.2 OPEN INNOVATION PIPELINE

WE WILL RUN and facilitate an open innovation pipeline. Teams across the world will have access to the pipeline to pick potential interventions, screen them and move them towards implementation.

The goal of the pipeline is to screen the universe of all potential abatement initiatives and eliminate those that do not meet implementation criteria of technical feasibility, abatement potential and speed. To do so, each potential intervention goes through three screens:

FIRST SCREEN: an open peer-review process in which a broad combination of operational, technical, financial and political criteria are applied to screen out initiatives that obviously will not be able to deliver an abatement return in the time-period required.

SECOND SCREEN: from the resulting 'secondary pool', Team Members pick a number of initiatives per month to stress test. The purpose of the stress test is to fail an initiative as soon as possible, thus eliminating it.

THIRD SCREEN: Once an initiative passes through the second screen, a sub-team is formed around the initiative to deliver it.

Passing each screen will allow an initiative to access a larger pool of capital via the Gigatonne Fund.

3.4.3.2 WARM DATA (INTELLECTUAL CAPITAL)

THE GIGATONNE STRATEGY as a whole will generate multiple streams of data. We anticipate data coming from multiple levels, including but not limited to the following:

1. Applications from Teams & Individuals to Seed Funds (Biographical Data)
2. Performance Data From Teams (Quarterly CROI Submissions)
3. Archival Data From Teams (for example about their process or learning)
4. Performance Data From Prototypes
5. Contextual Data (for example regulatory developments or policy data)
6. Transaction Data from the Marketplace.

See Section 3.5.1.2 for more on the Marketplace.

We see this data as "warm data"[36] because in a complex system this data only makes real sense inside of a context. This contextual background provides a sharp contrast to "cold" data that is generally viewed as being unrelated to context.

We imagine that these data flows will feed multiple information "products", for example the Open Innovation Pipeline.

36. "'Warm Data' can be defined as: Transcontextual information about the interrelationships that integrate a complex system. Warm Data is a specific kind of information about the way parts of a complex system, such as members of a family, organisms in the oceans, institutions in society, or departments of organization come together to give vitality to that system. By contrast, other data will describe only

3.4.3.3 GIGATONNE TEAMS AS OUTPUT (HUMAN + SOCIAL CAPITAL)

ONE OF THE core outputs from this strategy are multiple teams with the capabilities to respond to the climate crisis. This is the main equity result.

We envision that as Teams grow, they become the field from which more radical behaviour change initiatives emerge, resulting in more systemic responses to the climate crisis[37].

Gigatonne Teams, distributed around the world, will build their own contextually-sensitive cultures and responses to the climate crisis. Through the practical work of engaging multiple stakeholders in actual emissions reductions efforts, we imagine the human and social capital built being the basis for broader re-negotiations between civil society and communities, the private sector and the public sector.

the parts, while Warm Data describes their interplay in context. [...] Examples include understanding the systemic risks in health, ecology, economic systems, education systems and many more. The typical approach to issues decontextualizes specific information, which in turn can generate mistakes. On the other hand, warm data promotes coherent understanding of living systems." — Nora Bateson, The International Bateson Institute https://batesoninstitute.org/warm-data-labs/

37. One of the possible responses would be creating the conditions of the low energy demand (LED) scenario, in which global energy demand drops by 40% by 2050, despite rises in population, income and activity, limiting warming to 1.5°C without relying on NETs. See Arnulf Grubler et al, "A low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies," *Nature Energy*, no 3 (June 2018): 515–527

3.5 RESOURCES

CONVENTIONAL FINANCIAL ESTIMATES for gigatonne-scale reductions run from many tens of billions of dollars to over a trillion dollars per year, with annual mitigation investments growing at the rate of 0.36 % (between 0.2–6 1%) of global Gross Domestic Product (GDP) from 2015 to 2035[38].

The key assumption we have made around resourcing the Gigatonne Strategy — which we also make about all strategic responses in the climate space — is that there will never be enough liquidity to simply buy solutions outright. At least not in the volumes and timescales needed.

We are therefore proposing the Gigatonne Strategy is resourced through the investment of multiple forms of capital.

38. See Box 4.8 in Chapter 4 of IPCC SR15 Report https://www.ipcc.ch/sr15/chapter/chapter-4/

Estimated annualised mitigation investment between 2015 and 2035 (in trillion USD at market exchange rates)

	ENERGY INVESTMENTS	OF WHICH DEMAND SIDE
1.5°C SCEN.	$2.38TN	$0.54TN
MIN	$1.38TN	$0.38TN
MAX	$3.25TN	$1.13TN
2°C SCEN.	$2.13TN	$0.40TN

3.5.1 SOURCES OF CAPITAL

3.5.1.1 GIGATONNE SEED FUNDS

SEED FUNDS ARE designed to create cohorts of 5-10 Gigatonne Teams at a time. Potential teams, either formal or informal, apply to each Fund. We will establish Fund Criteria from a combination of technical requirements and specific requirements relating to capability.

Seed Funds will focus geographically. There is also a potential for Seed Funds to be sector-focused.

We anticipate Seed Fund sizes to start at USD$2.5M-$20M depending on the geography in which they are focused. Each Team is then financed for 2 cycles from the Seed Fund they apply to.

We envision the first Gigatonne Seed Fund to be launched in India. Eligible Teams are required to be based in any Indian city with a population of 1M+. Applications to the Gigatonne Fund will open in 2020.

See Section 6. Timeline for Start-Up Phase for more details.

Initially two types of Seed Fund will be set up: funds for which we raise the resources and funds for which partners, for example governments, provide the initial capital.

3.5.1.2 GIGATONNE MARKETPLACE

ALL TEAMS THAT meet the Open Gigatonne Protocol requirements will be eligible for listing on the Marketplace. The Marketplace connects Teams to financial capital.

We anticipate most Teams to meet the listing requirements after completing two six-month operational cycles. Teams listed on the Marketplace will be financed for a further 3, 6 or 9 cycles.

After these funding cycles are completed, Teams will either have attracted further financing via the Marketplace or they can apply for an extension to be funded for another series of cycles.

Teams will continue to meet the Open Gigatonne Protocols when they are listed, so for example they will continue to file quarterly CROI reports and ensure they are testing or developing 5 prototypes per operational cycle.

The Gigatonne Marketplace will initially be capitalised at USD$100M. We anticipate multiple sources of further financing in order to capitalise the Marketplace.

Examples of potential sources of financing include philanthropic gifts, a global "People's Climate Fund" crowdsourcing campaign in which we invite individuals to pledge 1% of their annual income for a decade, climate bonds and public sector funding earmarked for Teams operating in specific geographies.

Once the Marketplace is established and multiple Teams are listed, we envision testing multiple financing models, including using the Marketplace to finance for-profit teams mirroring more conventional venture capital and private equity markets.

For donors, the key advantage of putting capital into the Marketplace is that 99.9% of their money will go directly to Teams. These teams are directly fighting climate change through measurably meeting abatement, equity and temporal mitigation targets.

Donors will be able to track the performance of Teams on the Marketplace and also start making direct investments in Teams that they would like to support.

We are imagining the Marketplace developing to support multiple classes of donor and investor, from the individual to the institutional.

The Marketplace will be governed by a **Progressive Data Sharing Mandate**. As our market-share grows, we would share increasing volumes and subsets of our data with any other player in this sector that asks for it.

In other words, the greater concentration of capital in the Marketplace, the more data we would share. A Progressive Data

Sharing Mandate ensures that other players have access to data-sets allowing them to continue to innovate. This will benefit small, innovative start-ups much more than big players (who will have their own data-sets)[39].

39. "Data-rich markets aren't solving all our problems, nor are they without inherent structural weaknesses. The success of any data-driven market, therefore hinges on its design - and the rules under which it operates." - Viktor Mayer-Schonberger & Thomas Ramge, Capitalism In The Age Of Big Data

3.5.1.3 STAKEHOLDER CO-INVESTMENT

WE ARE ASSUMING that, for any at-scale response to the climate crisis to succeed, it requires co-investment from multiple stakeholders. We envision co-investment to take the form of both financial and non-financial forms of capital, with stakeholders investing their time (human capital), relationships (social capital), services and infrastructure (physical capital), data-sets, multiple forms of IP, and channels for data-dissemination (intellectual capital).

We currently envision these investments being made directly into Teams and being tracked through our CROI Reporting Framework.

See Section 4.1 Capital Returns On Investment (CROI) for more information.

3.5.2 INVESTMENT REQUIREMENTS

WE HAVE COSTED three different investment models for this strategy.

The first is a pure financial capital model, the second is a hybrid capital model with a 50% ratio between financial and non-financial capital, and the final is a primarily non-financial capital model with 95% of investment being non-financial capital.

The "hybrid capital" resourcing model is best suited to our requirements for Take-Off and End-State.

The resource requirements are presented in terms of capital type to demonstrate the input requirements and the possible outputs. The inputs are a mixture of financial and non-financial resources.

See Appendix F. Inputs & Outputs.

The financial resources are based on the following assumptions:

OPERATIONAL COSTS - This is the cost to run and support the teams through the fund. We estimate this to be in the region of $1.5m per team per cycle in order to enable teams to make a full-time commitment, and for us to provide logistical support and coaching. As the abatement requirements are lower during the Start-up Phase, we estimate that teams will be able to self-fund the majority of their operational expense, allowing us to support 10 teams with $1.5M

PROTOTYPE FUNDS – The resources provided to the teams to implement their prototypes. Due to the nature of the approach, our intention here is to provide an order-of-magnitude estimate for what will be required to meet the levels of abatement we are proposing. We have used a variety of figures to calculate an order of magnitude average abatement cost of $175 per ton of CO_2e.

The below figures are intended to be illustrative of possible requirements for the Start-Up, Take-Off and End-State phases. During the Start-Up phase we will build a more accurate assessment of the requirements for Take-Off and End-State.

3.5.2.1 START-UP REQUIREMENTS — PER CYCLE

WE AIM TO launch between 10 and 50 teams during the Start-Up Phase, which we expect to last 2 to 4 cycles (1 to 2 years). During this phase, we will test our assumptions regarding the funding required to run the teams and to obtain the level of abatement we seek.

We expect each team's operational and prototyping costs to vary according to its location, with teams in the Global South having substantially lower costs. The table below illustrates the requirements per cycle in two possible locations, India and Canada.

START-UP REQUIREMENTS — PER CYCLE	INDIA	CANADA
TEAMS	10	10
EMISSIONS TARGET (tCO_2e) PER TEAM – MIN	2,500	2,500
EMISSIONS TARGET (tCO_2e) PER TEAM – MAX	10,000	10,000
OPERATIONAL COSTS	$800,000	$1,500,000
PROTOTYPE FUND (APPROX OoM)	$12,250,000	$17,500,000

PURE FINANCIAL: 0% IN-KIND	$13,050,000	$19,000,000
HYBRID: 50% IN-KIND	$6,925,000	$10,250,000
NON-FINANCIAL: 95% IN-KIND	$1,500,000	$2,400,000

3.5.2.2 TAKE-OFF REQUIREMENTS – PER CYCLE

TAKE-OFF PHASE	ALPHA	BETA	GAMMA	DELTA	EPSILON
TEAMS	1,000	2,000	3,000	4,000	5,000
EMISSIONS TARGET (tCO_2e) PER TEAM	50,000	25,000	16,667	12,500	10,000
OPERATIONAL COSTS	$1.4BN	$2.9BN	$4.3BN	$5.7BN	$7.2BN
PROTOTYPE FUND (APPROX OoM)	$8.8BN	$8.8BN	$8.8BN	$8.8BN	$8.8BN
PURE FINANCIAL: 0% IN-KIND	$10.2BN	$11.7BN	$13.1BN	$14.5BN	$16BN
HYBRID: 50% IN-KIND	$5.1BN	$5.8BN	$6.5BN	$7.3BN	$7.9BN
NON-FINANCIAL: 95% IN-KIND	$509M	$581M	$653M	$725M0	$797M

3.5.2.3 END-STATE REQUIREMENTS - PER CYCLE

END STATE PHASE	ALPHA	BETA	GAMMA	DELTA	EPSILON
TEAMS	1,000	2,000	3,000	4,000	5,000
EMISSIONS TARGET (tCO_2e) PER TEAM	500,000	250,000	166,667	125,000	100,000
OPERATIONAL COSTS	$1.4BN	$2.9BN	$4.3BN	$5.7BN	$7.2BN
PROTOTYPE FUND (APPROX OoM)	$87.5BN	$87.5BN	$87.5BN	$87.5BN	$87.5BN
PURE FINANCIAL: 0% IN-KIND	$88.9BN	$90.4BN	$91.8BN	$93.2BN	$94.7BN
HYBRID: 50% IN-KIND	$44.5BN	$45.2BN	$45.9BN	$46.6BN	$47.3BN
NON-FINANCIAL: 95% IN-KIND	$4.4BN	$4.5BN	$4.6BN	$4.7BN	$4.8BN

3.5.2.4 ESTIMATE OF REQUIREMENTS – YEAR 1 TO YEAR 5

THE GRAPH BELOW shows a possible evolution of financial requirements during the first five years. Please note that it aims only to illustrate the difference between the requirements at Start-Up and later on, once the number of teams starts growing exponentially along with the level of CO_2e emissions reduction.

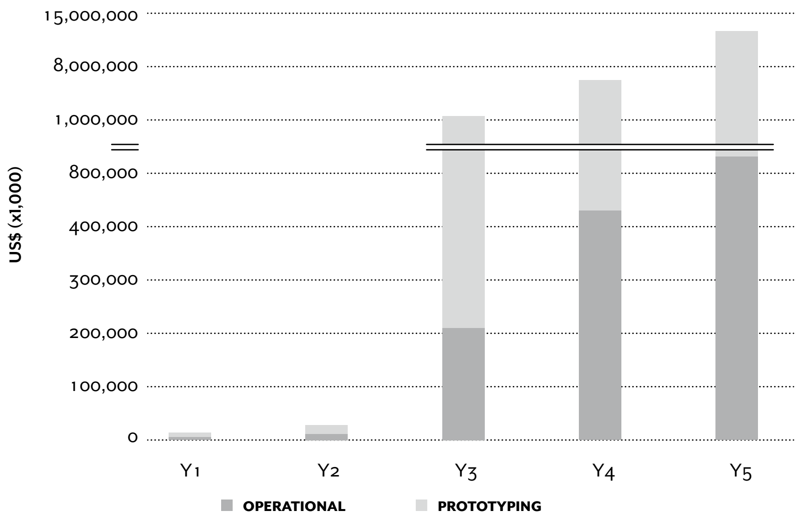


FIG 8. Illustrative evolution of requirements Y1-Y5

4. MEASUREMENT

4.1 CAPITAL RETURNS ON INVESTMENT (CROI)

OUR OVERALL APPROACH to measurement is to view both inputs and outputs in terms of multiple capitals:

- **HUMAN CAPITAL** or new capacities
- **SOCIAL CAPITAL** or increased trust and equity in the system
- **INTELLECTUAL CAPITAL** or new knowledge and information
- **PHYSICAL CAPITAL** or new products, services or infrastructure
- **FINANCIAL CAPITAL** or new stocks (and flows) of financial capital
- **NATURAL CAPITAL** or ecosystem services (such as trees or cleaner air)

We will be prototyping a **Capital Return On Investment (CROI) Reporting Tool**. Our focus will be to ensure that:

1. This is a practical tool that can be used to generate real-time, shared data on performance.
2. Investors can have confidence that teams are delivering a return on investment.

We anticipate that initial Gigatonne Teams will be trained during the Gigatonne Bootcamp on a Version 1.0 prototype of the CROI reporting tool that will include documentation and a digital dashboard.

4.1.2 HOW CROI WORKS

STEP 1: ESTABLISH A BASELINE OF CROI EXPECTATIONS

At the start of each operational cycle, teams will be required to make a subjective assessment of their capability to generate impact in each of the six areas. The baseline would be captured via an online platform, where teams can track and compare their assessments.

STEP 2: QUARTERLY ASSESSMENT OF CROI

Every quarter, teams come together to do a quick review of their assessments and update their performance based on the actual impact achieved since the baseline workshop. There will be a series of metrics relevant to each type of capital to record objective performance.

CROI is designed as a "lite" framework. A key aspect of the framework is ensuring a focus on usability for the teams — providing them with a straightforward way to capture data against each of their metrics. This will be done via an online dashboard or mobile application.

STEP 3: GENERATING A "CONFIDENCE SCORE"

The deviation between subjective and objective assessments will be used to create a 'Confidence Score' which will enable teams to be ranked relative to each other.

4.1.2.1 MEASURING & TRACKING CO_2e EMISSIONS

WE ENVISION USING a widely accepted existing standard for measuring, tracking and verifying CO_2e emissions. Examples of these GHG accounting standards include the ones provided by the Greenhouse Gas Protocol[40] and the International Financial Institutions Technical Working Group on Greenhouse Gas Accounting[41], which offer useful frameworks for assessing energy efficiency prototypes.

Open-source platforms, such as the De-risking Energy Efficiency Platform (DEEP), that monitor and benchmark investments in energy efficiency, can be integrated with our CROI Reporting Tool, allowing us to standardise each team's contributions and follow their progress.

To ensure the reliability of the data provided by the teams, we consider using third-party auditing.

40. "Standards," Greenhouse Gas Protocols, accessed September 2019, https://ghgprotocol.org/standards

41. International Financial Institutions Technical Working Group On Greenhouse Gas Accounting, *IFI Approach to GHG Accounting for Energy Efficiency Projects*, 2019.

4.1.3 VALUE OF CROI FOR TEAMS

THE CROI DIGITAL dashboard will allow teams to access the following:

CROI EVALUATION

Once a CROI Baseline Evaluation has been run, an Evaluation Report can be generated. Quarterly Evaluations (each taking no longer than 15 minutes) will generate a picture of how the team is performing.

CROI RANKING

Once CROI evaluations are run for multiple teams, a scorecard could be generated, for example, ranking teams by Platinum, Gold, Silver or Bronze ratings.

CROI TRACKING

Teams will eventually establish a performance track record, allowing donors and investors to see how effective teams have been over time.

4.2 REAL-TIME PERFORMANCE DATA

AS REAL-TIME DATA starts flowing in, we will be able to move from a probability model for the number of teams required and the abatement target per prototype (see 2.1.4 Success Scenarios) to real-time adjustments based on actual performance data.

We will understand what is working and what is not, and why; for instance, we will know whether the teams need to stress-test more ideas and implement fewer, whether they need to implement more or whether more teams are needed.

Evaluation of team performance will not primarily be based on ex-ante predictions of performance (although subjective ex-ante assessments will be made) but increasingly on ex-post performance data.

We anticipate that this real-time performance data will also allow us to look at factors such as the success of teams, including actual prototype abatement and equity data.

Once teams are established and operational, we will be supporting them to build a real-time sensor network that will allow for increased granularity of data from the context that each team works in.

4.3 THE GIGATONNE FEEDBACK LOOP: CONNECTING LOCAL ACTION TO GLOBAL TARGETS

AS THIS DATA flows from established teams we will have created a feedback loop between local efforts and a shared global goal of gigatonne-scale reductions, allowing each team to track its contribution. This feedback loop, once a sufficient number of teams are operational, will also allow us to track a picture of how the aggregate of distributed, local teams are contributing to global emissions reduction.

The absence of such a feedback loop means that currently there is no way of assessing the collective efficacy of climate abatement efforts, other than through the crudest of measures, such as greenhouse gas contributions in the atmosphere.

We anticipate this feedback loop —which we are calling the Gigatonne Feedback Loop — will allow us to make strategic interventions, ranging from increasing the number of teams to increasing the level of resources needed to address the climate crisis.

5. RISKS AND MITIGATION

5.1 BASELINE RISK: THE BUSINESS-AS-USUAL SCENARIO

THE CLIMATE LITERATURE spells out the risks of Business-As-Usual (BAU) emission scenarios fairly clearly[42]. We know that if we do not manage to keep global temperatures below 2°C, we risk overshoot.

IPCC's estimate for global economic damages due to 1.5°C of warming by 2100 amounts to $54tn, rising to $69tn for 2°C[43]. Overshooting takes us into costs that are hard to fathom; for example, a 4°C temperature rise might lead to a planet with a carrying capacity of one billion, meaning the loss of many billions of people. Such costs make BAU scenarios emotionally unacceptable, even as emissions continue to increase due to BAU behaviours.

As such we deem the risks associated with launching the Gigatonne Strategy to be extremely low, requiring relatively modest investment. As we proceed from the Start-Up Phase to the Take-Off and End-State Phases, the level of risk will naturally increase as the variables and resource requirements grow. By this point, however, the actual risks of operationalising the strategy will have become clearer.

42. See Chapter 1 of IPCC SR15 Report https://www.ipcc.ch/sr15/chapter/chapter-1/

43. See Box 3.6 in Chapter 3 of IPCC SR15 Report https://www.ipcc.ch/sr15/chapter/chapter-3/

5.2 RISKS FOR THE GIGATONNE STRATEGY

THE GIGATONNE STRATEGY will not succeed if the CO_2e abatement doesn't occur at the scale and pace needed or if it fails to deliver on its equity goals. In our analysis, we identified three types of risks: strategic, tactical and those associated with the dimension of the endeavour, which we called 'megaproject risks'.

Below we outline megaproject, strategic and tactical risks, along with our approach to mitigating them.

5.2.1 AVERTING DANGEROUS CLIMATE CHANGE AS A MEGAPROJECT

THE SCALE OF the climate crisis rapidly takes us into 'megaproject' terrain. While the term was originally coined to describe multi-billion dollar infrastructure projects, it can be applied to climate strategies given that we now regularly see multi-trillion dollar numbers put forward as the cost of averting dangerous climate change(44).

Megaprojects come with inherent risks that in this case could prove catastrophic. Costs are often underestimated while benefits are overestimated, which may lead to poor execution and disappointing results(45).

The Gigatonne Strategy is structurally designed to avoid some of the features that might put it into the megaproject category, thus potentially mitigating some of the risks associated with projects of this size and cost. Key features include:

1. **DISTRIBUTED TEAMS.** Teams manage their own budgets. This generally means that they learn to operationalise without megaproject pressures. As budgets grow, megaproject risks such as optimism bias and strategic lying become real possibilities.
2. **MULTI-SECTORAL TEAMS.** As participants are drawn from multiple sectors, the culture of no single organisation or sector necessarily dominates. Team members have to negotiate a co-created culture of response. This obviously presents us with more unprecedented risks but it avoids the group-think and siloed responses of single-sector strategies.
3. **6-MONTH OPERATIONAL CYCLES.** Teams operating in 6-month operational cycles, broken down into monthly and then weekly cycles, mean an ability to pivot and change direction depending on what emerges.
4. **AGILE PROJECT MANAGEMENT**. Agile avoids the problems of traditional, prescriptive project management (which often characterises megaprojects). Learning is built into the operating culture of teams. Agile regimes allow for teams to practice and get better through the forward feedback cycles embedded into the processes.

44. See Box 4.8 in Chapter 4 of IPCC SR15 Report https://www.ipcc.ch/sr15/chapter/chapter-4/

45. For more information on the effects of optimism bias and strategic misrepresentation on megaproject management, see Flyvbjerg, B., Nils Bruzelius, and Werner Rothengatter. *Megaprojects and risk.* Cambridge: Cambridge University Press, 2003.

Cost overruns of 50% to 100% in real terms are common in megaprojects; overruns above 100% are not uncommon; demand forecasts that are wrong by 20% to 70 % compared with actual developments are common; the extent and magnitude of actual environmental impacts of projects are often very different from forecast impacts. Post-auditing is neglected." — **BENT FLYVBJERG** / MEGAPROJECTS AND RISK: AN ANATOMY OF AMBITION

5. **MULTIPLE PROTOTYPES.** As teams operationalise and go through multiple cycles, testing multiple prototypes, a probability model will emerge based on real experience and real data. We will be able to look across an entire portfolio of abatement efforts to know what failure rates to expect and how operations would need to change in order to increase the odds of success.

Despite these features a number of strategic and tactical risks remain, which we discuss below.

5.2.2 STRATEGIC RISKS

RISK	MITIGATION
A FAILURE TO CONVINCE SUFFICIENT ACTORS TO DEPART FROM BAU RESPONSES	DISTRIBUTED TEAMS CONNECT WITH LOCAL POCKETS OF CLIMATE LEADERSHIP AND INNOVATION
A FAILURE TO RAISE SUFFICIENT START-UP CAPITAL	MULTIPLE CAPITAL SOURCES, FROM PHILANTHROPIC TO PUBLIC FUNDS, PROVIDE DIVERSIFICATION
A FAILURE TO RAISE SUFFICIENT CAPITAL TO LAUNCH THE MARKETPLACE	HIGH-QUALITY PERFORMANCE DATA THAT ALLOWS FUNDERS TO CONFIDENTLY ALLOCATE CAPITAL DIVERSIFIED CAPITAL, INCLUDING GRANTS, LOANS, AND EQUITY, FROM PUBLIC AND PRIVATE SOURCES
OPTIMISM BIAS – UNDERESTIMATING COSTS AND/OR OVERESTIMATING BENEFITS	REFERENCE CLASS FORECASTING (*see Appendix E*)
EMERGENT COMPLEXITY – UNFORESEEN RISKS	RED TEAM – AN ADVISORY TEAM OF ACADEMICS, PRACTITIONERS AND STAKEHOLDERS THAT REGULARLY HIGHLIGHTS RISKS THAT MIGHT AFFECT THE GT STRATEGY
POLITICAL WILL FOR MITIGATION EFFORT COLLAPSES	DISTRIBUTED TEAMS IN VARIOUS GEOGRAPHIES REDUCE EXPOSURE TO POLITICAL RISK

5.2.3 TACTICAL RISKS

WHILE THERE ARE countless tactical risks, the structural features of the GT Strategy are designed for a degree of responsiveness. Consequently, we will focus on the immediate tactical risks presented by the Start-Up Phase.

RISK	**MITIGATION**
FLAWED TEAM SELECTION PROCESS	TEAM APPLICATIONS FOR START-UP PHASE WILL BE ASSESSED BY A DIVERSE GROUP OF STAKEHOLDERS AS THE NUMBER OF TEAMS GROW, DATA ON FACTORS AFFECTING TEAM PERFORMANCE WILL BE INTEGRATED INTO THE TEAM SELECTION PROCESS.
DYSFUNCTIONAL TEAMS	TEAMS WILL BE SUPPORTED BY EXPERIENCED SYSTEMS PRACTITIONERS TEAM INTERACTIONS ARE DESIGNED TO FOSTER COOPERATIVE BEHAVIOUR (*see Appendix B – Collaborative by Design*)
10IN10 GROUND TEAMS DYSFUNCTIONAL	SELECTION OF EXPERIENCED SYSTEMS PRACTITIONERS FOR 10IN10 GROUND TEAMS
CROI REPORTING FRAMEWORK NOT DEVELOPED IN TIME	APPLICATION OF AGILE METHODOLOGY TO ENSURE TIMELY DEVELOPMENT OF A MINIMUM VIABLE PRODUCT
A FAILURE TO SOCIALISE THE IDEA IN THE GLOBAL CLIMATE COMMUNITY	SOFT LAUNCH AT COP MADRID GLOBAL GT LAUNCH AT SALZBURG SEMINAR + GLASGOW COP

6. TIMELINE FOR START-UP PHASE

THE TABLE BELOW illustrates the timeline for launching and running 2 cycles with 10 teams during the Start-Up Phase.

TIMELINE FOR LAUNCHING THE 10 FIRST TEAMS

MONTH	INPUTS	PROCESS	DURATION	OUTPUTS
1-3	GIGATONNE FUND ADEQUATELY CAPITALIZED AND GEOGRAPHIC SCOPE AGREED TECHNICAL CRITERIA FOR APPLICANTS APPLICATION PROCESS	PUBLIC CAMPAIGN	3 MONTHS	POOL OF APPLICATIONS FOR GIGATONNE TEAMS
4	DUE DILIGENCE & SELECTION CRITERIA	SELECTION OF GIGATONNE TEAMS	1 MONTH	10 GIGATONNE TEAMS SELECTED
5	OPERATIONAL + PROTOTYPING FUNDS FOR 1ST CYCLE	ANNOUNCEMENT OF WINNERS	1-MONTH NOTICE BETWEEN ANNOUNCING WINNERS & BOOTCAMP 1	CAMPAIGN ANNOUNCES WINNERS
6	10 TEAMS – MAX 5 PEOPLE PER GIGATONNE TEAM REPORTING PLATFORM IN PLACE COMPLEXITY U LIVE	RESIDENTIAL 'FOUNDATION' BOOTCAMP 1	1 MONTH	FOUNDATIONAL CAPACITY BUILT IN UP TO 50 PEOPLE 10 GIGATONNE TEAMS SET-UP FOR REPORTING
7-11	ONGOING SUPPORT VIA COMPLEXITY U	OPERATIONAL CYCLE 1	5 MONTHS	5 PROTOTYPES PER TEAM X 10 = 50 PROTOTYPES EACH GIGATONNE TEAM WILL REPORT AT START OF CYCLE, AT 3 MONTHS AND AT THE END OF THE CYCLE = 5 MONTHS OF PERFORMANCE DATA INCREASED CAPACITIES BUILT IN UP TO 450 PEOPLE
12	10 TEAMS – MAX 5 PEOPLE PER GIGATONNE TEAM	RESIDENTIAL "MASTER CLASS" BOOTCAMP 2	2 WEEKS	ADVANCED CAPACITY BUILT IN UP TO 50 PEOPLE
12-17	OPERATIONAL + PROTOTYPING FUNDS FOR 2ND CYCLE ONGOING SUPPORT VIA COMPLEXITY U	OPERATIONAL CYCLE 2	6 MONTHS	5 PROTOTYPES PER TEAM X 10 = 50 PROTOTYPES EACH GIGATONNE TEAM WILL REPORT AT START OF CYCLE, AT 3 MONTHS AND AT THE END OF THE CYCLE = 6 MONTHS OF PERFORMANCE DATA INCREASED CAPACITIES BUILT IN UP TO 450 PEOPLE 10 GIGATONNE TEAMS LISTED ON THE MARKETPLACE
18		FIRST GIGATONNE FUND WIND-DOWN		10 GIGATONNE TEAMS (450+ PEOPLE) WITH INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES 50 OPERATING PROTOTYPES (50% SUCCESS RATE): 50 EPSILON PROTOTYPES (MIN) = 50,000 TONNES CO_2e ABATEMENT 50 ALPHA PROTOTYPES (MAX) = 200,000 TONNES CO_2e ABATEMENT OPERATIONAL AND PROTOTYPING FUNDS DISBURSED

APPENDICES

A. SYSTEM CONDITIONS TO LIMIT GLOBAL WARMING TO 1.5ºC OR 2ºC

ACCORDING TO THE IPCC, there are a number of system conditions and requirements that need to be met in any pathway with a 50-66% probability of limiting warming to 1.5°C with no or limited (less than 0.1°C) overshoot or to 2°C[46].

	1.5°C PATHWAYS		2°C PATHWAYS	
CONDITIONS	**SHORT-TERM REQUIREMENTS**	**LONG-TERM REQUIREMENTS**	**SHORT-TERM REQUIREMENTS**	**LONG-TERM REQUIREMENTS**
STAYING WITHIN THE CARBON BUDGET: **580 $GTCO_2$ FROM 2018 FOR 1.5°C** **1500 $GTCO_2$ FROM 2018 FOR 2°C**	REDUCE EMISSIONS TO 20.3 $GTCO_2$ BY 2030 ANNUAL DECLINE OF 1.8 $GTCO_2$ IN 2020-2030	REACH NET-ZERO[47] BY 2050 AND -10.2 $GTCO_2$ BY 2100 ANNUAL DECLINE OF 1.0 $GTCO_2$ IN 2030-2050	REDUCE EMISSIONS TO 28.9 $GTCO_2$ BY 2030 ANNUAL DECLINE OF 1.1 $GTCO_2$ IN 2020-2030	REACH NET-ZERO BY 2070 AND - 5.1 $GTCO_2$ BY 2100 ANNUAL DECLINE OF 0.9 $GTCO_2$ IN 2030-2050
DECARBONIZING THE ENERGY SUPPLY SYSTEM RAPIDLY	DECREASE THE SHARE OF PRIMARY ENERGY FROM FOSSIL FUELS TO 83% BY 2020 AND 67% BY 2030 INCREASE THE SHARE OF PRIMARY ENERGY FROM RENEWABLES TO 15% IN 2020 AND 29% IN 2030	COMPLETE DECARBONIZATION OF ELECTRICITY SECTOR BY 2050 DECREASE THE SHARE OF PRIMARY ENERGY FROM FOSSIL FUELS TO 33% BY 2050 INCREASE THE SHARE OF PRIMARY ENERGY FROM RENEWABLES TO 60% IN 2050	SLOWER DECREASE OF THE SHARE OF FOSSIL FUELS AND INCREASE OF THE SHARE OF RENEWABLES IN PRIMARY ENERGY SUPPLY	COMPLETE DECARBONIZATION OF ELECTRICITY SECTOR BY 2050 HIGHER RESIDUAL FOSSIL FUEL USE AND LOWER HYDRO, SOLAR AND WIND POWER DEPLOYMENT THAN 1.5°C PATHWAYS
RAMPING UP MITIGATION EFFORTS IN END-USE SECTORS (INDUSTRY, BUILDINGS AND TRANSPORT)	DECREASE IN ENERGY DEMAND BY 2030 66% DECREASE OF CARBON INTENSITY OF ELECTRICITY BY 2030	GLOBAL ENERGY CONSUMPTION GROWS 10% FROM 2010 TO 2050, WHILE ENERGY CONSUMPTION IN END-USE SECTORS GROWS BY 30% CARBON INTENSITY OF ELECTRICITY BECOMING NEGATIVE BY 2050	SAME LEVEL OF ENERGY DEMAND BY 2030 50% DECREASE OF CARBON INTENSITY OF ELECTRICITY BY 2030	GLOBAL ENERGY CONSUMPTION GROWS 30% FROM 2010 TO 2050, WHILE ENERGY CONSUMPTION IN END-USE SECTORS GROWS BY 20% CARBON INTENSITY OF ELECTRICITY BECOMING NEGATIVE BY 2070

46. Rogeli et al., "Mitigation pathways compatible with 1.5°C in the context of sustainable development" in *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, ed. Masson-Delmotte et al. (in Press)

47. **Net-zero or real-zero?** It has often been suggested that net-zero pledges that fail to demonstrate a clear and rapid path to a decarbonized energy system are but a license to keep emitting CO2 while relying on large-scale deployment of future negative emission technologies (NETs) to draw it out of the atmosphere. The current uncertainty around the efficacy, scalability, cost and impacts of NETs highlight the risks of such net-zero claims. Although it would be nearly impossible to achieve real-zero, given the non-CO2 emissions associated with agriculture, the likelihood of limiting warming to 1.5°C with no or little overshoot is much higher in scenarios that show faster decarbonization and no reliance on NETs.

DEPLOYING CO_2-REMOVAL TECHNOLOGY (CDR) AT SCALE BY 2050	RESOLVE THE UNCERTAINTIES AROUND LARGE-SCALE DEPLOYMENT OF TECHNOLOGICAL CDR, NAMELY CCS TECHNOLOGIES	DEPLOY AN APPROPRIATE MIX OF LAND-USE AND TECHNOLOGICAL CDR TO COMPENSATE CONCURRENT CO_2 EMISSIONS. LIMITED USE OF CDR TO PRODUCE NET NEGATIVE CO_2 EMISSIONS BY 2050, INCREASING SUBSTANTIALLY BY 2100. CUMULATIVE CDR DEPLOYMENT OF UP TO 100 $GTCO_2$ BY 2050 AND 800 $GTCO_2$ BY 2100	LESS RELIANCE ON CDR	DEPLOY AN APPROPRIATE MIX OF LAND-USE AND TECHNOLOGICAL CDR TO COMPENSATE CONCURRENT CO_2 EMISSIONS (ABOUT 40% THAN IN 1.5^{O}C PATHWAYS). VERY LIMITED USE OF CDR TO PRODUCE NET NEGATIVE CO_2 EMISSIONS BY 2050, INCREASING SLIGHTLY BY 2100. CUMULATIVE CDR DEPLOYMENT OF UP TO 50 $GTCO_2$ BY 2050 AND 500 $GTCO_2$ BY 2100
SHIFTING INVESTMENT AWAY FROM FOSSIL FUELS[48]	AVERAGE MITIGATION COSTS: $220/TCO2 BY 2030 RENEWABLE ENERGY AND ENERGY EFFICIENCY INVESTMENTS TO EACH INCREASE BY UP TO 550 BILLION $/YR ON AVERAGE TO 2050 FILL INVESTMENT GAP FOR LOW-CARBON ENERGY AND ENERGY EFFICIENCY INVESTMENT OF 460 BILLION US$/YR EVERY YEAR UNTIL 2030 LOW-CARBON SUPPLY-SIDE INVESTMENTS MUST OVERTAKE FOSSIL INVESTMENTS BY AROUND 2025, INCREASING TO OVER 80% BY 2035 STOP INVESTMENTS IN UNABATED COAL BY 2030	AVERAGE MITIGATION COSTS: $750/ TCO_2 BY 2050 AND $3000/TCO2 BY 2100 FILL INVESTMENT GAP FOR LOW-CARBON ENERGY AND ENERGY EFFICIENCY INVESTMENT OF 1560 US$/YR OUT TO 2050	AVERAGE MITIGATION COSTS: $120/$TCO_2$ BY 2030 INVESTMENTS ARE 3-24% LOWER THAN IN 1.5^{O}C PATHWAYS FILL INVESTMENT GAP FOR LOW-CARBON ENERGY AND ENERGY EFFICIENCY INVESTMENT OF 300 BILLION US$/YR EVERY YEAR UNTIL 2030	AVERAGE MITIGATION COSTS: $350/ TCO_2 BY 2050 AND $1500/$TCO_2$ BY 2100 FILL INVESTMENT GAP FOR LOW-CARBON ENERGY AND ENERGY EFFICIENCY INVESTMENT OF 1050 US$/YR OUT TO 2050 LOW-CARBON SUPPLY-SIDE INVESTMENTS MUST REPRESENT OVER 80% OF TOTAL BY 2050

48. Additional data from: International Institute for Applied Systems Analysis, IIASA Policy Brief - How much to invest to mobilize change in the energy system?, 2018 https://unfccc.int/sites/default/files/resource/367_Investments_Policy_Brief_2018-10-26.pdf

B. COLLABORATIVE BY DESIGN

THE GIGATONNE TEAMS are engaged in a distributed but collaborative effort to reduce CO_2e emissions by 1 Gt per year. Each team assesses and reports its impact quarterly using the CROI Reporting Tool, which tracks and ranks its performance. To avoid creating a purely competitive environment, we will use game design principles to encourage cooperation and trust.

These principles will inform the design of many of the structural elements of the Gigatonne Strategy, such as:

- CROI Reporting Tool, which is used to collect and share impact and performance data
- Gigatonne Growth Protocol, which governs the creation of new teams by existing teams
- Open Innovation Pipeline, which provides ideas for prototypes

Marketplace, which supplies financing for emission reduction prototypes and initiatives.

DESIGN PRINCIPLES TO ENCOURAGE COOPERATION

IN ORDER TO elicit cooperation in an evolutionary environment(49), participants ought to:

49. Robert M. Axelrod, *The Evolution Of Cooperation* (New York: Basic Books, 2006)

BE NICE. Promoting mutual interest rather than exploiting weaknesses elicits cooperation. If a participant is seen as 'nice', others know what to expect and act accordingly, thus creating the conditions for cooperative strategies to outperform exploitative strategies.

BE RECOGNISABLE. The success of a 'nice' strategy depends on the likelihood of reciprocation when the participants meet again. To reciprocate, participants must be able to recognize each other and keep a record of their previous interactions. In practical terms, this means that data must be linked data back to its source to build a reputation.

The following mechanisms contribute to the evolution of cooperation(50) and can also be used as design principles:

50. Martin A. Nowak, "Five Rules for the Evolution of Cooperation", Science 314 (December 2006):1560-1563, http://www.ped.fas.harvard.edu/people/faculty/publications_nowak/Nowak_Science06.pdf

KIN SELECTION. Donor and recipient of an altruistic act share the same ideas.

DIRECT RECIPROCITY. There are repeated encounters between the same two individuals.

INDIRECT RECIPROCITY. A helpful individual is more likely to receive help.

NETWORK RECIPROCITY. Clusters of cooperators outcompete lone 'bad guys'.

GROUP SELECTION. Competition occurs not only between individuals but also between groups.

USING NON-FINANCIAL INCENTIVES TO FOSTER COLLABORATION

ALTHOUGH WE MIGHT provide financial incentives for certain behaviours (e.g., a team that launches another team to implement one of its prototypes in a new context might be rewarded with extra prototyping funds), most incentives will be non-financial.

Non-financial incentives are used to connect with the participants' innate drives[51]:

THE ACQUIRING DRIVE. Reward people with goods, power, and social status virtually, within the system.

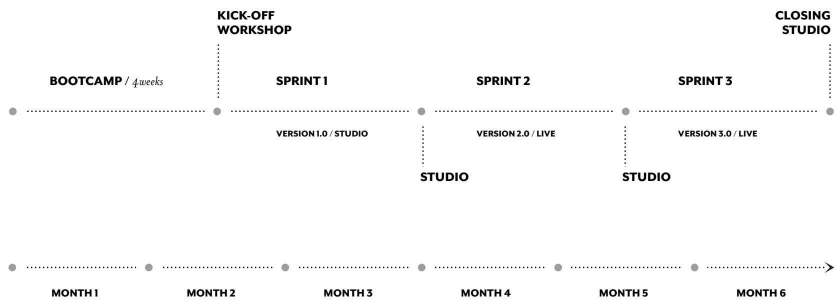
THE BONDING DRIVE. Reward people with positive personal relationships and create feelings of belonging, camaraderie and unity to build the community.

THE LEARNING DRIVE. Reward people by showing how they have helped make sense out of the world, to find meaning, to satisfy they natural curiosity, to solve problems and to overcome challenges.

THE DEFENSE DRIVE. Reward people by showing how they have helped to reduce a threat – physical and/or psychological, including to the environment, to their status, their ideas.

51. Paul R Lawrence and Nitin Nohria, *Driven* (San Francisco: Jossey-Bass, 2002)

C. ANATOMY OF AN OPERATIONAL CYCLE



GIGATONNE BOOTCAMP

AT THE BEGINNING of each cycle, the Gigatonne Team will attend a unique bootcamp offering a cutting-edge learning experience. The focus of this bootcamp is to begin to learn how to address complex socio-political and environmental challenges.

Prototyped over the last ten years at universities such as the New School in New York, the California College of Arts, the Kaospilots in Denmark and Swaraj University in Udaipur, India, this bootcamp programme will provide participants with a combination of contextually specific learning-by-doing coupled with diverse classroom and individual learning experiences to suit a myriad of learning styles.

During the bootcamp teams will receive rigorous training in:

- Designing an effective strategy
  - How to constitute and build effective teams
  - How to design effective, iterative and experimental processes
  - How to set-up an “agile” project management regime
  - How to design the architecture of your intervention including governance,information design, capacity and innovation functions
- Producing multi-capital results
  - Understanding the multiple capitals framework including social, human, information, financial, physical and natural

capital.
- Understanding how a genuinely "sustainable" strategy is designed.

Each bootcamp will be held in the context of the geography of each fund (e.g. a fund working in Delhi would have a bootcamp in Delhi). The first boot camp will be a 4-week residential experience and the second will be over two weeks.

KICK-OFF WORKSHOP

AT THE KICK-OFF, each Gigatonne Team is divided into 5-6 sub-teams to design and test prototype initiatives for abating CO2e emissions. Team Members will develop a deeper understanding of the challenge, practices and protocols, how to work as a team and what is needed during the subsequent sprints and studios.

SPRINT 1

DURING THE FIRST sprint, sub-teams stress test emission reduction ideas for prototypes. The ideas may come from the Open Innovation Pipeline or a number of other sources (e.g., initiatives like Drawdown and Exponential Roadmap provide excellent starting points). If an idea passes the test, the sub-team starts implementing version 1.0 of their prototype. If it fails, they select another idea and start again.

STUDIO 1

AT THE FIRST studio, the sub-teams come together to present version 1.0 of their prototypes. Teams share experiences, learning and resources, address challenges, receive coaching and importantly reflect on and review progress. They decide whether they need to pivot, persevere, or stop (radically change) their prototype. The planning for the next Sprint focuses on how to take their prototype "live"/ version 2.0.

SPRINT 2

EACH SUB-TEAM WORKS on their prototype version 2.0, implementing it in live conditions.

STUDIO 2

FOLLOWING THE SECOND sprint, teams invite external guests to the Studio. They come to hear and provide advice, feedback and coaching to the Prototyping sub-teams on their Version 2.0 live prototypes. Teams plan Sprint 3 and their final tests for the Cycle.

SPRINT 3

EACH SUB-TEAM WORKS on their prototype version 3.0, running their final tests.

STUDIO 3

AT THE FINAL Studio, Teams present their “final”/ Version 3.0 prototype results to an even wider network of external guests, stakeholders and end users. Feedback, coaching and decisions on continuation of the prototypes into the next Cycle are made. Teams complete this Cycle and prepare for the next.

D. MITIGATING OPTIMISM BIAS WITH REFERENCE CLASS FORECASTING

THE CONCEPT OF "optimism bias" is used to explain the fact that planners in public policy persistently underestimate the costs and overestimates the benefits of large projects, often for political reasons.

Bent Flyvbjerg, Daniel Kahneman, Dan Lovallo and other researchers have developed the concept in the analysis of large-scale projects (transport, dams, etc.) but not in the context of climate change, in some ways a much more complicated and even more politicized field.

In order to help confront the problem of optimism bias, Daniel Kahneman and Amos Tversky developed the theory of **reference class forecasting** and Professor Bent Flyvbjerg adapted the methodology for use in policy decisions[52].

To mitigate the risk of optimism bias in the implementation of the Gigatonne Strategy, we will use reference class forecasting in order to determine the accuracy of estimates made regarding the costs of CO_2e abatement initiatives and the multiple capital return on investment that they predict.

The basic premise of the methodology is to separate prototypes into 'classes' or types of similar prototypes. We would then collect data regarding the anticipated costs and returns and the delivered costs and returns for similar prototypes to create a database. After a significant number of prototypes are analysed and included in the database, we'll be able to establish a probability distribution to determine the average percentage of disparity between the projected and actual costs and returns. This difference – which Flyvbjerg referred to as the "optimism bias uplift" – can then be used to better predict the costs and returns of future prototypes.

Reference class forecasting corrects for the different perceptions of the "inside view" and the "outside view." An inside view focuses narrowly on the project whereas an outside view considers the current project in the context of other similar projects, allowing for a more accurate appraisal of the costs and benefits of the

52. For more information about the methodology, please see: Bent Flyvbjerg, "Curbing Optimism Bias and Strategic Misrepresentation in Planning: Reference Class Forecasting in Practice," *European Planning Studies*, 16:1 (2008): 3-21. Also please see Bent Flyvbjerg and COWI, *Procedures for Dealing with Optimism Bias in Transport Planning: Guidance Document.* (London: UK Department for Transport, 2004).

project itself[53].

To start, there will be no record of how well our approach will work. Tracking optimism bias in several Gigatonne Teams will lead to the development of a **reference class database**.

This work will deliver a data-set that allows teams and other stakeholders to make more accurate forecasts as to how much prototypes will cost and what kind of return they will provide.

53. Daniel Kahneman and Amos Tversky, eds., *Choices, Values, and Frames* (Cambridge: Cambridge University Press, 2000), 406

E. WHO ARE WE

OUR TEAM HAS extensive experience across philanthropy, civil society, the private and public sectors.

We are former CEOs, strategists, facilitators, researchers, project managers, and community organisers. We have managed multi-billion-dollar foundations and agile start-ups. We have deep sectorial expertise and wide networks of relationships to draw on. Some of us are grizzled and others are young. We are always learners and sometimes teachers.

Collectively, we have already supported many thousands of people in tackling complex challenges. 10-in-10 will allow us to distribute those skills and support with the speed and scale necessary to reinvent the future. All of us have a deep commitment to tackling complex challenges around the world. This is our work.

10-IN-10 TEAM

MANISH JAIN
Co-founder

Manish has 25 years of experience working with grassroots leaders, young people, and local communities. The vision behind his work is that people are inherently creative when freed from the constraints of factory schooling and externally imposed development paradigms.

He co-founded Shikshantar: The Peoples' Institute for Rethinking Education and Development, which has brought thousands of learners together over 20 years. He is co-founder of Swaraj University, built on Gandhi's ideas of self-rule. He is also co-founder of Ecoversities Alliance, a network of 100+ alternative universities globally. Recently, he founded the Jail University in a maximum-security.

ZAID HASSAN

Co-founder and CEO

Zaid has 20 years of experience tackling complex social challenges all over the world, ranging from working in rural India on reducing acute child malnutrition to tackling racism, violence, and youth unemployment in inner-city Chicago.

A pioneer of new approaches to tackling complexity involving teaching people how to tackle their own challenges, Zaid has supported and advised many organisations on multi-stakeholder strategies over the years, including the World Bank, the UN, the Climate Action Network, WWF, Oxfam, and several governments.

Zaid regularly teaches and guest lectures at universities worldwide, including the New School in New York, the University of Bergen in Norway, and the University of Oxford. He is the author of The Social Labs Revolution: A New Approach to Solving Our Most Complex Challenges.

VINITA CHANDRIKAPRASAD

Co-founder

Vinita has 23 years of experience in organisational effectiveness, leadership/team development, and coaching. Her clients include Google, IBM, Unilever, GlaxoSmithKline, and Abbott Laboratories, as well as working as a resource person with Indicorps. She is anchoring a local initiative, the 'Panchgani Youth Leaders Fellowship', where she engages with issues such as environment, education, livelihood, health, and human development. She also runs a coaching, consulting, and training organisation in western India.

LEO EISENSTADT

Director of Finance

Leo has been working at the intersection of complexity, finance, and operations for over ten years. He played an instrumental part in launching the global social labs community and in 2016, he co-Founded Roller Strategies. He was Finance Manager at Reos Partners for several years, before leaving to lead the transformation and sale of a popular online meeting scheduler in 2015. Leo lives by the motto "Keep It Simple, Stupid." Leo loves spreadsheets and fintech, and is striving to leave the planet a better place.

TARA RAO

Director of Strategy

Over the last 30 years, Tara, an architect by trade, has employed her design skills through working with governments, as well as bilateral and multilateral organisations in Asia, Africa, and beyond in the areas of social development and environmental issues – covering climate-resilient development, corporate social responsibility, human right education and campaigning, organisational development, and social infrastructure design.

She brings experience in consensus and team building for issue-based impact. Through designed and facilitated collaborative processes, she has brought diverse sets of people and entities together to get alignment, strategise, and operationalise collective strategies. She has worked with WWF, Amnesty International, Green Peace, CARE, the UN, the World Bank, and various governments (Vietnam, Nepal, Bhutan), among others. She sees herself as an ever-evolving storyteller playing with multiple future scenarios that are constantly informed by today's action.

ALENKA ZAVASNIK

Head of Programmes

Over the past 20 years Alenka has worked on international initiatives and events supporting entrepreneurs, social entrepreneurs, youth, and change-makers in capacity building, becoming resilient leaders, creating connections, and growing communities. She worked for over ten years at CEED (Center for Entrepreneurship and Executive Development) and SEAF emerging markets investment management group in their field office in Slovenia and HQ in Washington D.C.

Alenka has spearheaded initiatives for growing entrepreneur networks in South-East Europe and Africa and building capacities of entrepreneurs to scale their businesses and access mentors. She was additionally involved in several multi-partner projects on entrepreneurship and employment funded by the European Commission.

LUCY WHITE

Gigatonne Challenge Coordinator

Lucy has 15+ years of experience in impact entrepreneurship, events, start-up leadership, group facilitation and coaching. She is passionate about inspiring and empowering changemakers, unlocking the potential of collaborative action, and supporting teams to thrive and reach impact. Past clients include Synchronicity Earth, WWF, The Lankelly Chase Foundation, and UNPRI.

Lucy holds a BA and MA from Cambridge University in Chinese Studies, worked as a conference producer in the energy, transport and financial sectors, trained in Equine Facilitated Learning and Therapeutic Arts Facilitation, and co-founded a sustainable tourism and events venue and is a trained Art of Hosting practitioner. She enjoys travel, long walks in nature with her dog, creative play, yoga and dance.

SWETA DAGA

Gigatonne Challenge Coordinator

Sweta has worked across several platforms, including film, television, journalism, and theatre. She has engaged in social justice, gender, water issues, and climate change issues for over ten years. She co-created India's first-ever environmental reality TV show on NDTV and has worked with organisations like the People's Archive of Rural India, Pratham Books, The Gates Foundation, Yes!, The Forum for Environmental Journalists and Elevar Equity, among others.

SHIKHER GUPTA

CROI Development

Shikher brings experience in reporting, audit and software development. Shikher holds a degree in finance and has worked in corporate consulting and audit, global operations reporting for a major tyre manufacturer, and as a business analyst and project manager with a software company for non-profit and corporate clients. A self-taught programmer, Shikher is also a spreadsheet consultant. He is working on the Complexity Marketplace, reporting, assessments and research. Shikher likes travelling, taking pictures and writing poetry.

SUJAY CHINNAM

Platforms Coordinator

Sujay is the tech guy who is also an experiential educator, trained counsellor, and certified football coach. He manages the tech needs of the organization, web platforms for online learning, and community building. In his spare time, he uses sports as a medium to connect with marginalised communities. As an experiential educator, Sujay facilitates activity-based silumations and co-operative games that teach through feedback and reflection. He also coaches Gigatonne Challenge teams. Sujay is a big-time foodie and a biker.

KAAJAL KHODE

Course Coordinator

Kaajal has a Bachelor's degree in Business Administration alongside a Diploma in Finance. During her education, she has worked with a few startups. She is passionate about being a problem solver and being able to contribute to the growth of businesses at an early stage. Kaajal is always open to learning new things and getting things done. She has 3+ years of experience organising and coordinating non-commercial events. That's where her creativity and organising skills meet. Kaajal works in operations as a Course Coordinator. Going ahead she is looking forward to finding herself in a facilitator role. Kaajal likes doing henna art, journaling, watching movies, travelling and meeting new people.

ADVISERS

BANNY BANERJEE

Professor of Practice and Director of ChangeLabs, Stanford University

Banny has worked in the field of innovation and design for 30 years. He is well known for his pioneering work in design thinking, advanced systems-based innovation methodology, and systems leadership models for large-scale transformations in multi-dimensional challenges.

MANISH BAPNA

President and CEO, Natural Resources Defence Council

Manish has focused on designing sustainable development strategies, policies, and programs to address the twin challenges of climate change and inequity in his multiple leadership roles. He previously served as Interim President and CEO of the World Resources Institute and Executive Director of Bank Information Center.

VIVEK BHANDARI

Chairman, Jio Payments Bank

Vivek is a historian and academic who has a growing interest in issues of financial technology and rural livelihoods. He was previously Director of Institute of Rural Management Anand (IRMA), a premier management school, and worked as a consultant to philanthropic trusts such as the Sir Dorabji Tata Trust, Sir Ratan Tata Trust, and the Reliance Foundation.

GABRIELLA ETMEKTSOGLOU

Director, New York University (Berlin)

Gabriella is committed to reshaping higher education, especially global education so it becomes a central driver in creating a more humane and sustainable world. She is a founding member of the National Peace Academy.

SALEEMUL HAQ

Director, The International Centre for Climate Change and Development (ICCCAD)

Saleemul is recognised as one of the top global influencers on climate change policy. He was the lead author of the Adaptation and Sustainable Development chapter in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). He also advises the Least Developed Countries (LDC) group in the United Nations Framework Convention on Climate Change (UNFCCC).

TERRY MAZANY

Former President and CEO, Chicago Community Trust

Terry is the former president and chief executive officer for the Chicago Community Trust, engaging donors in comprehensive, innovative programs for impactful grant-making and doubling the community foundation's assets to more than $2.8 billion USD. The Chicago Community Trust is the third-largest community foundation in the United States.

MINH-THU PHAM

Former Director of Global Policy, UN Foundation

Minh-Thu worked with diverse stakeholders to create and deliver the Sustainable Development Goals (SDGs) to end extreme poverty, curb climate change, and tackle inequality. She also served as strategy and policy advisor to UN Secretary-General Kofi Annan.

WASIF RIZWI

Founding President, Habib University

Wasif led the vision and creation of the first liberal arts institution of higher learning in Pakistan. He has established collaborations with leading institutions, including Carnegie Mellon University, Texas A&M University at Qatar, Stanford University, University of Michigan, and the Claremont Consortium of Liberal Arts Colleges.

FELICITY TAN

Special Advisor, Partnerships & Coalitions at The Rockefeller Foundation

Felicity is a strategist and connector. She is currently co-piloting partner identification, development and cultivation for an unprecedented collective action platform that aims to channel $10 billion USD into climate finance. The platform was launched at COP26 in Glasgow.

MARC VENTRESCA

Associate Professor of Strategic Management, Said Business School, University of Oxford

Marc's areas of expertise include market and network formation, entrepreneurship, governance, and innovation and technology strategy. His research and teaching focus on the formation of markets and networks in business and social settings—specifically, how markets are built and the actors who build them.

COACHES & FACULTY

EVAN LAM

Strategist | Systems Entrepreneur | Creative

Working as a systems entrepreneur, Evan draws on a colourful range of experiences and perspectives. Raised on the Big Island of Hawai'i, Evan has worked as a professional chef, cannabis entrepreneur, advisor and project leader. He's currently working on a venture to localize organics recycling on Hawai'i Island through distributed infrastructure.

The core of Evan's work is to practically improve the relationship between the human world and the natural world. Evan joined the Gigatonne Challenge in 2020 to convene, and support teams, including a team in Hawai'i who have progressed to Level 3.

ASAWARI MATHUR

Earth Buddy | Entrepreneur | Learner

Asawari is a self-directed life learner without any degrees, who has always crafted her own path to living life. An earth buddy, she is passionate about living a life that's in harmony with nature. She runs a business of natural personal care products called Dhanak Naturals. Apart from her business she works as a facilitator, and particularly enjoys working with children and youth.

Asawari lives in a village, Bodichipalli, near Bangalore, India. She loves living in nature with her family, dogs and cats. She enjoys cooking, doing art, dancing, music and is into a regular practice of yoga and meditation.She has been a team member of the Gigatonne Challenge Bangalore team since Oct 2020, where she enjoys the energy of prototyping and the team effort to work towards a common goal.

INDRANI SHARMA

Anchor| Enabler | Crusader

Indrani brings with her 20 years of project management and facilitation experience in engaging with social entrepreneurs and development initiatives. She has served leadership roles in organizations of repute both nationally and internationally. For the last 12 years, she has served in consulting roles on interesting social impact projects ranging from youth innovation to livelihood and women's empowerment. She is self-driven and goal-oriented and treats life as a learning journey, following which she likes to engage in challenging projects that offer her self development in new spheres.

Indrani has been a team member of the Gigatonne Challenge Coaching Team since Oct 2021 and is committed to working towards actions that offer solutions to the current climate crisis situation that threatens our planet. Indrani enjoys motherhood as her primary occupation and is based out of Chennai.

VISHAL RASAL

Environmentalist | Researcher | Coach

Vishal is an environmental researcher based in Mumbai and he has been working on environmental projects for more than 10 years now. His work has enabled him to travel across the country to work and be friends with people from diverse cultural backgrounds. He believes in small steps that could make small changes towards creating a better world.

Vishal has been a Gigatonne Challenge coach since November 2021 and is deeply inspired by action learning and working with prototyping Teams. Currently, he is working in the State Knowledge Management Centre For Climate Change, Maharashtra. He loves to travel and is part of a leading trekking group in Mumbai. An interesting thing to know about Vishal is that he always has stories to tell.

LINN FRIEDRICHS

Educator | Researcher | Co-Learner

Linn is a researcher and educator trained in North American Studies, Modern History, and Political Science and is currently based in Berlin, Germany. Convinced that we can create a truly inclusive education system and solve the complex challenges of our time if we collaborate as co-learners across cultural, disciplinary, and generational differences, Linn's work, research, and teaching have focused on global curriculum development in higher education, new approaches to activist academics, and "glocal" community learning.

Currently, Linn serves as the Assistant Director for Student Life and Community Learning at New York University Berlin and teaches a course on Experiential Learning that integrates her students' academic development with the work of local organizations in the fields of climate research, refugee support, communication, and the arts.

PANCHAKSHI BALIYAN

Engineer | Strategy Analyst | Fitness Trainer

Panchakshi hails from Muzaffarnagar city of Uttar Pradesh, India and is B. Tech Graduate in Biotechnology, after which she has pursued a corporate sales career for 7 years working with organizations like FedEx and Wakefit. She has been very active in sports since her childhood and now continues her fitness regime with Yoga and aerobics. She works as a part-time fitness advisor and trainer to keep her passion for physical fitness.

As the wife of a Defence Officer, she is very disciplined in her routine life and enjoys experiencing new places, languages, cultures and communities by the virtue of frequent transfers of her husband. Panchakshi enjoys her personal and professional life to the fullest and maintains the balance between them to keep the equilibrium.

ABHILASHA NIMESH

Seeker | Artist | Neophile

Abhilasha holds a postgraduate degree in Business Administration with a specialization in “Human Resources (HR)”. She is an experienced professional in the areas of generalist HR. She has held a wide range of responsibilities in HR such as end-to-end employee life cycle operations, employee engagement, talent development, compliance, to name a few. One of her favourite quotes about people is “If we treat people as they are, they will remain as they are but if you treat them as they ought to be they will become bigger and better”.

As a reflection on this quote, Abhilasha believes that there is a big world of people looking to raise their comfort zone, to be known as someone who helped, cared, and listened when it was needed the most. Abhilasha’s interest in complex systems made her look more critically into interconnections and the impact of human activity on the planet. Keeping the sensitive balance of cause and effects in her view is really imperative.

ANANYA PATEL

Interdisciplinary Creative | Facilitator | Designer

Ananya is a designer interested in exploring holistic and interdisciplinary perspectives that create social change. In this pursuit, she has gained varied experience since studying multidisciplinary design at Goldsmiths College - as an illustrator, researcher, writer, programme designer and facilitator, and briefly as an archivist reframing colonial narratives between Britain and Vadodara, where she is currently based. These projects often fall in the intersections between gender, cultural identity and ecology, and look at systemic issues through a creative lens.

Ananya has presented work at the Victoria & Albert Museum, South London Gallery, Lakshmi Vilas Palace Vadodara, Dutch Design Week, and the first Trans-South East Asia Triennial in Guangzhou. Currently, Ananya runs an illustration practice, participates in a global women artists’ collective, facilitates workshops on communication, and supports a local initiative educating and employing women in climate justice work.

TARISAI JANGARA

Communication Specialist | Journalist | Public Relations

Tarisai is a development Communications Specialist having worked as a journalist, editor and public relations officer. She holds Masters in Communication for Development from the University of Zambia and a Bachelor of Arts in English and Communication from Midlands State University in Zimbabwe.

From 2016–to 2020, Tarisai was the Communications Specialist at the Zambian Governance Foundation. She currently works with the same title at the Global Fund for Community Foundations.

STEPHEN KARIUKI KIBOI

Environmental Activist | Management Specialist | Climate Action Facilitator

An environmental defender and activist with a background in Business Admin and management, Stephen is determined to fight against climate change in the Global South. He is among the founders and veterans of 350.org Powershift Kenya. Stephen has experience in the Horticultural and Agricultural sector, having served as the Operations & Logistics manager for more than 7-years in leading export industries in Kenya at the (JKIA) airport. With over 10 years of experience in HR, Agronomy, Operations, Production & Logistics, Stephen has a rich knowledge of serving different organizations. He works to source, safeguard and facilitate resource acquisition for organizations, communities and environmental self-help groups.

Stephen has been engaged in climate advocacy and governance in Kenya for 10+ years and is the Founder and Chief Executive Officer of MT. KENYA NETWORK FORUM, National Climate Finance Thematic Lead (a Kenya Platform for Climate Governance), Executive Board Member at the Centre for Climate Action, and in charge of informal settlement Areas Civic Education in Nairobi for URAIA TRUST Foundation.

JOYEUX MUGISHO

Human Rights Activist | Peer Educator on Gender-Based Violence | Coach

Joyeux is a Human Rights activist and is very passionate about refugees and street children's rights. He is a peer educator on Sexual and Gender-Based Violence. He is also the Executive Director of a non-profit organization called People for Peace and Defence of Rights, which is a human rights organization that focuses on advocacy and bettering the livelihood of refugees and Internally Displaced youth known as street children (IDPs). Additionally, he is the founder and chairman of the Network of Congolese Civil Society Organisations in East Africa.

Joyeux has gained a lot of experience while working in research studies with Toronto University and has coached students at Ghent University on refugees and forced migrant issues in East Africa. Joyeux has 12 years of experience in humanitarian organisation work. He has been involved in life coaching and career guidance for students joining universities, financial literacy training, counselling and courses on the application of human-centred Design and Design Thinking to solve problems affecting communities.

KALPANA KABRA

Analyst | Teacher | Entrepreneur

Kalpana started her journey as a homemaker after completing post-graduation in Zoology from Calcutta University. She did a programmer's course in computers early on and was selected for teaching programming at the same institute. She opened her own sub-brokerage firm under a well-established broker. Furthermore, she has worked for Mathews Easow Research securities limited, Religare securities, and CD Equisearch in the capacity of a technical analyst. Her job included writing daily newsletters.

Kalpana has also taught technical analysis at BIFS for many years and has been a guest lecturer at various places. She is an avid reader, a nature lover and very interested in the cause of the climate and environment. Kalpana is very positive and flexible to fit in any role of delivery or reconstruction.

JONN KMECH

LISTENER | HELPER | CONNECTOR

Jonn has worked and volunteered in a variety of different areas, including journalism, scientific research, human rights, interfaith appreciation, and mental health. A writer at heart, after working as an editor, he graduated with a degree in physiology and worked for several years on multiple sclerosis research. After that, he switched to homelessness prevention and reduction in rural areas, including co-organizing the first national conference in Canada focused on rural and remote homelessness and affordable housing.

It was during his work on homelessness that he developed an interest in complex systems, which brought him to Complexity University in 2020. The Gigatonne Challenge is his first foray into climate work. Jonn's been a facilitator, content coordinator, moderator, coach, interviewer, and listener, and he enjoys finding patterns and connecting people. He currently works at his local library and volunteers at his local crisis line. In his spare time, Jonn practices Zen Buddhism, and likes reading, learning, and punk.

GRACE SAJI

Environmental Scientist | Campaign Communications | Facilitator

Grace has experience working across the iNGO, community organisation and corporate spaces. She has mentored teams based in both the local and international contexts. She has a graduate degree in environmental sciences, with a published research paper that maps the desertification risk states in the Eastern Ghats of India. She has worked on a range of policy and action-oriented campaigns in the RE, air pollution and waste sectors with Greenpeace India.

Grace was also the coordinator and facilitator of a community-based digital study programme for school dropouts in Kolkata's slums. She is currently a marketer with a Singapore-based media house. Grace brings dimensions of her interests in participatory development, the nuances of power dynamics, the wild, storytelling, and creativity to all that she does.

HULUNN CHOO

Environmentalist/ Activist/ Volunteer

Hulunn's environmental career began with working on solutions to the landfill problem in South Africa. She bought a franchise that conducted carbon audits and carbon tax calculations, being an environmentalist. She then moved into conducting workshops and presentations at schools which led to her joining Greenpeace Africa as a volunteer and activist.

With her experience and continued training in environmental work, Hulunn is launching "Activating Leaders for Global regeneration" workshop in April 2022, for the youth wanting to take action but feeling the anxiety that comes with this massive task of (a) cutting down on the Greenhouse gases humanity produces, (b) working on the story we tell ourselves about why we cannot take action and (c) creating a society that does not deplete nature. Hulunn's dream is to build an Ecovillage and Green school in-between forest and mountains.

PANKAJ PUSHKAR

Policy Researcher | Legislator | Connector

Pankaj is a public policy researcher, self-reflective practitioner and nomad legislator. During the last 25 years, he has been in various journeys that connect peoples' movements, communitarian learning spaces, formal academia and political processes. This diverse set of experiences culminates in tenure as a member of the legislative assembly in Delhi. Pankaj Pushkar gets an understanding that the reality around is intrinsically and increasingly complex and formal academia and bureaucracy are designed to avoid these complexities.

Along with many fellow travelers Pankaj deploys these intersectional experiences to work out a strategic breakthrough and to address pressing challenges in innovative ways. This makes him a believer, explorer and mobiliser of the stories of unchained human potential. Pankaj Pushkar works with governments, communities and civil society organizations to explore and expand mutually enriching collaborations.

SONU VASHI

Positive | Innovative | Out-of-the-Box Thinker

Sonu has served as a senior management professional for over a decade for luxury hotel brands and undertook responsibilities in sales & marketing, revenue, PR, communications, media, and corporate social responsibility. A leader driven by quality and commitment, who has significant and progressive experience in formulating marketing and sales strategies that produce accelerated performance results, Sonu can thrive in a fast-paced environment and is adaptive to changing scenarios.

VARUN SENGAR

Consensus-builder | Storyteller | Strategist

As a digital designer, Varun has been freelancing & working with The Singhania Group, Viacom18, and various F&B outlets & event companies on their digital collaterals and assets like artwork for signage, logos, menus, etc. Varun spent the majority of his career in corporate sales jobs of well-known hospitality brands such as The Leela, Pullman, Novotel, and Holiday Inn. In the nascent stages of his career, Varun was also involved in selling insurance, building custom motorcycles, and being part of events and acting gigs. Varun is an avid traveller and nature lover who at least once a year visits the mountains and indulges in natural landscapes.

MONIKA SAXENA

Trainer |Consultant |Coach

Monika brings a diverse range of experiences and perspectives to her work as a trainer, facilitator, consultant, and coach. Monika is the founder of 90ten Training and Consulting. She has more than twenty-five years of experience comprising a very interesting mix of sales, consulting, training, and organisational development in organisations like NIIT, American Express, and Samsung. After graduating with a degree in physics, she completed her MBA. She is a certified coach and a Neuro-Linguistic Programming (NLP) practitioner. She is committed to the cause of education for the underprivileged, supporting an NGO called Taleem and serving on their advisory board. Monika, over the last few years, has been working extensively on diversity & inclusion and the women leadership agenda of different organisations. Physics is her love, spirituality and travel fascinate her, and family & friends give meaning to her life.

THARUN KUMAR

Sports Coach | Experiential Educator |Networker

Though he holds a diploma In electrical engineering, Tharun is an integral part of development programs in his community. He has worked with NGOs, sports organisations, educational institutions & political parties. He uses sports as a medium to connect with youth, children, and elders through activities created to raise awareness of life & the needs of the community. These activities stimulate & nurture the ability to reflect as anindividual. He was a national-level Ball Badminton player. He speaks Telugu, Hindi, and Dakhini.

STUART MINNAAR

Entrepreneur| Start-Up Ecosystem Expert | Founder of Networks

An entrepreneur by blood type, Stuart's first tech company was a mobile payments app in South Africa (Yappo). As an MBA graduate (Rotary International Scholar) from IE Business School (Madrid), he understands the unromantic work of running a startup and how to use business acumen to ensure stable growth. He is part of a number of organisations and networks within the startup ecosystem; he is a World Economic Forum Global Shaper, a partner at StartupBus Africa, a judge of Startup Chile, a Selection Committee Member of the UN Nelson Mandela Peace Summit, founder of the European Network for African Business Clubs, country partner for Design for Change and one of the founding members of the South African Chamber of Commerce in Spain.

Stuart is currently a partner at an impact investment consultancy (Fundie Ventures) in Madrid, Spain, which he started while doing his MBA. He is also the board member of a children's foundation based in the Netherlands. Stuart is part of the Gigatonne Challenge Faculty.

F. INPUTS & OUTPUTS

NOTE: ALL FIGURES ARE INDICATIVE AND INTENDED TO PROVIDE AN ORDER-OF-MAGNITUDE SENSE OF THE RESOURCES REQUIRED TO OPERATIONALISE THE GIGATONNE STRATEGY.

F0. COST OF CARBON EMISSIONS

WE'VE USED A figure of $175 per ton for the abatement cost of carbon. This has been calculated based on an average of a range of different abatement options[54]. Cost estimates that we have found range from -$190 per ton to nearly $3,000, depending on where the abatement comes from. Even within the same categories the range can be similar.

This figure is intended to provide an order of magnitude scale for our calculations of the cost of implementing this strategy. This figure is equivalent to an answer to the question "how long is a piece of string" - The answer will be refined as the strategy develops, and as each phase gets underway and abatement opportunities become clearer and teams are in a position to better assess the resource requirements.

ABATEMENT APPROACH	$ PER TON OF CO_2 (LOW)	$ PER TON OF CO_2 (HIGH)	$ MIDPOINT
ADVANCED NUCLEAR	59		59
AGRICULTURAL EMISSIONS POLICIES	50	65	57.5
BEHAVIOURAL ENERGY EFFICIENCY	-190		-190
BIODIESEL	146	420	283
CAFE STANDARDS	-107	307	100
CASH FOR CLUNKERS	270	420	345
CLEAN POWER PLAN	11		11
COAL RETROFIT WITH CCS	85		85
CONCENTRATING SOLAR POWER EXPANSION	100		100
CORN STARCH ETHANOL	-18	310	146
DEDICATED BEV SUBSIDY	350	640	495
ENERGY EFFICIENCY PROGRAMS (CHINA)	297		297
GASOLINE TAX	18	47	32.5
LIVESTOCK MANAGEMENT POLICIES	71		71

54. Sources:
- https://scholar.harvard.edu/files/stock/files/gillingham_stock_cost_080218_posted.pdf
- https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf
- https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/Impact%20of%20the%20financial%20crisis%20on%20carbon%20economics%20Version%2021/Impact%20of%20the%20financial%20crisis%20on%20carbon%20economics%20Version%2021.ashx
- https://obamawhitehouse.archives.gov/omb/oira/social-cost-of-carbon

ABATEMENT APPROACH	$ PER TON OF CO_2 (LOW)	$ PER TON OF CO_2 (HIGH)	$ MIDPOINT
ADVANCED NUCLEAR	59		59
AGRICULTURAL EMISSIONS POLICIES	50	65	57.5
BEHAVIOURAL ENERGY EFFICIENCY	-190		-190
BIODIESEL	146	420	283
CAFE STANDARDS	-107	307	100
CASH FOR CLUNKERS	270	420	345
CLEAN POWER PLAN	11		11
COAL RETROFIT WITH CCS	85		85
CONCENTRATING SOLAR POWER EXPANSION	100		100
CORN STARCH ETHANOL	-18	310	146
DEDICATED BEV SUBSIDY	350	640	495
ENERGY EFFICIENCY PROGRAMS (CHINA)	297		297
GASOLINE TAX	18	47	32.5
LIVESTOCK MANAGEMENT POLICIES	71		71
LOW CARBON FUEL STANDARD	100	2900	1500
METHANE FLARING REGULATION	20		20
NATIONAL CLEAN ENERGY STANDARD	51	110	80.5
NATURAL GAS COMBINED CYCLE	27		27
NEW COAL WITH CCS	95		95
NEW NATURAL GAS WITH CCS	43		43
OFFSHORE WIND	105		105
ONSHORE WIND	25		25
REDUCING FEDERAL COAL LEASING	33	68	50.5
REFORESTATION	1	10	5.5
RENEWABLE FUEL SUBSIDIES	100		100
RENEWABLE FUEL STANDARD	1	72	36.5
RENEWABLE PORTFOLIO STANDARDS	0	240	120
SOIL MANAGEMENT	57		57
SOLAR PV SUBSIDIES	140	2100	1120
SOLAR THERMAL	133		133
UTILITY SCALE SOLAR PV	29		29
WEATHERIZATION ASSISTANCE PROGRAM	346		346
WHITE HOUSE SOCIAL COST ESTIMATE	3	46	24.5
WIND ENERGY SUBSIDIES	-6	260	127
AVERAGE			**174.60**

F1. START-UP PHASE – PER CYCLE / 10 TEAMS

CAPITAL INPUTS <	INDIA	CANADA	UNIT
NATURAL CAPITAL			
EMISSIONS REDUCTION TARGET	50,000-200,000	50,000-200,000	tCO_2e TOTAL (5KT PER TEAM)
HUMAN CAPITAL			
NUMBER OF TEAMS	10	10	TEAMS
SECRETARIAT	50	50	PARTICIPANTS TO FILL SECRETARIAT ROLES AMONGST EACH TEAM (5 PER TEAM)
IN-KIND TIME CONTRIBUTIONS	400	400	TEAM MEMBERS ABLE TO SELF-FUND THEIR PARTICIPATION (40 PER TEAM)
PHYSICAL CAPITAL			
BOOTCAMP	1	1	SPACE REQUIRED FOR STARTUP BOOTCAMP
WORKSPACE	10	10	WORKSPACES PROVIDED IN-KIND FOR THE TEAMS TO USE AND WORK FROM FOR THE DURATION OF THE CYCLE
SOCIAL CAPITAL			
EXISTING RELATIONSHIPS AMONGST TEAM MEMBERS	450	450	ASSUMES 45 PER TEAM
INTELLECTUAL CAPITAL			
10-IN-10 FUND PROCESS	1	1	
FINANCIAL CAPITAL			
OPERATIONAL COSTS	$800,000	$1,500,000	USD$
PROTOTYPE FUND (APPROX ORDER OF MAGNITUDE)	$12,250,000	$17,500,000	USD$
TOTAL FINANCIAL CAPITAL REQ.	**$13,050,000**	**$19,000,000**	**USD$**
HYBRID CAPITAL REQ.: 50% IN-KIND	$6,925,000	$10,250,000	USD$
NON-FINANCIAL CAPITAL REQ.: 95% IN-KIND	$1,500,000	$2,400,000	USD$

CAPITAL OUTPUTS (TARGET) >	INDIA	CANADA	UNIT
NATURAL CAPITAL			
EMISSIONS REDUCED BY	50,000-200,000	50,000-200,000	tCO_2e TOTAL (5KT PER TEAM)
HUMAN CAPITAL			
TEAMS	10	10	FUNCTIONAL TEAMS BUILT
INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES	450	450	PEOPLE WITH INCREASED CAPACITY AND SKILLS. 45 PEOPLE PER TEAM.
PHYSICAL CAPITAL			
PROTOTYPES TESTED	50	50	PROTOTYPES TESTED - 5 X PER TEAM PER CYCLE

SOCIAL CAPITAL			
NEW RELATIONSHIPS AND TRUST IN THE SYSTEM	4550	4550	NEW RELATIONSHIPS MINUS TEAM MEMBERS WHO ARE PAID TO BE INVOLVED
INTELLECTUAL CAPITAL			
THE GIGATONNE PROTOCOL	V1.0	V1.0	
FINANCIAL CAPITAL			
MARKETPLACE	V1.0	V1.0	
FUNDS DISPERSED	$800,000	$1,500,000	USD$
FUNDS DIRECTLY SPENT ON PROTOTYPES	$12,250,000	$17,500,000	USD$
TOTAL FINANCIAL CAPITAL DISBURSED	**$13,050,000**	**$19,000,000**	**USD$**
HYBRID CAPITAL DISBURSED: 50% IN-KIND	$6,925,000	$10,250,000	USD$
NON-FINANCIAL CAPITAL DISBURSED: 95% IN-KIND	$1,500,000	$2,400,000	USD$

F2. TAKE-OFF PHASE – PURE FINANCIAL PER CYCLE

	SCENARIO					UNIT/COMMENT
CAPITAL INPUTS <	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCTION TARGET PER TEAM (tCO_2e)	50,000	25,000	16,667	12,500	10,000	50 $MtCO_2e$ TOTAL PER CYCLE
HUMAN CAPITAL						
NUMBER OF TEAMS	1,000	2,000	3,000	4,000	5,000	TEAMS
SECRETARIAT	5,000	10,000	15,000	20,000	25,000	PARTICIPANTS TO FILL SECRETARIAT ROLES AMONGST EACH TEAM (5 PER TEAM)
IN-KIND TIME CONTRIBUTIONS	0	0	0	0	0	TEAM MEMBERS ABLE TO SELF-FUND THEIR PARTICIPATION (40 MAX PER TEAM)
TEAM MEMBERS ENGAGED	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
PHYSICAL CAPITAL						
BOOTCAMP	0	0	0	0	0	SPACES PROVIDED IN-KIND FOR STARTUP BOOTCAMP
WORKSPACE	0	0	0	0	0	WORKSPACES PROVIDED IN-KIND FOR THE TEAMS TO USE AND WORK FROM FOR THE DURATION OF THE CYCLE
SOCIAL CAPITAL						
EXISTING RELATIONSHIPS AMONGST TEAM MEMBERS	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
INTELLECTUAL CAPITAL						
10-IN-10 FUND PROCESS	1	1	1	1	1	
FINANCIAL CAPITAL						
OPERATIONAL COSTS	$1,437,300,000	$2,874,600,000	$4,311,900,000	$5,749,200,000	$7,186,500,000	USD$
PROTOTYPE FUND (APPROX ORDER OF MAGNITUDE)	$8,750,000,000	$8,750,000,000	$8,750,000,000	$8,750,000,000	$8,750,000,000	USD$
TOTAL FINANCIAL CAPITAL REQ.	**$10,187,300,000**	**$11,624,600,000**	**$13,061,900,000**	**$14,499,200,000**	**$15,936,500,000**	**USD$**

CAPITAL OUTPUTS >	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCED BY PER TEAM (tCO_2e)	50,000	25,000	16,667	12,500	10,000	50 $MtCO_2e$ TOTAL PER CYCLE
HUMAN CAPITAL						
TEAMS	1,000	2,000	3,000	4,000	5,000	FUNCTIONAL TEAMS BUILT
JOBS CREATED	45,000	90,000	135,000	180,000	225,000	PEOPLE EMPLOYED DIRECTLY BY THE GIGATONNE FUND (LAB TEAMS - IN-KIND TIME CONTRIBUTIONS)

INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES	45,000	90,000	135,000	180,000	225,000	PEOPLE WITH INCREASED CAPACITY AND SKILLS. 45 PEOPLE PER TEAM.
PHYSICAL CAPITAL						
PROTOTYPES TESTED	5,000	10,000	15,000	20,000	25,000	PROTOTYPES TESTED - 5 X PER TEAM PER CYCLE
SOCIAL CAPITAL						
NEW RELATIONSHIPS AND TRUST IN THE SYSTEM	455,000	910,000	1,365,000	1,820,000	2,275,000	NEW RELATIONSHIPS (EACH TEAM ASKED TO ENGAGE WITH MIN. 500 PEOPLE IN THEIR SYSTEM) MINUS TEAM MEMBERS WHO ARE PAID TO BE INVOLVED
INTELLECTUAL CAPITAL						
THE GIGATONNE PROTOCOL	V2.0	V2.0	V2.0	V2.0	V2.0	
FINANCIAL CAPITAL						
MARKETPLACE	V2.0	V2.0	V2.0	V2.0	V2.0	
FUNDS DISPERSED INTO SYSTEM	$1,437,300,000	$2,874,600,000	$4,311,900,000	$5,749,200,000	$7,186,500,000	USD$
FUNDS PER PROTOTYPE	$1,750,000	$875,000	$583,333	$437,500	$350,000	
FUNDS DIRECTLY SPENT ON PROTOTYPES	$8,750,000,000	$8,750,000,000	$8,750,000,000	$8,750,000,000	$8,750,000,000	USD$
TOTAL FINANCIAL CAPITAL DISBURSED	**$10,187,300,000**	**$11,624,600,000**	**$13,061,900,000**	**$14,499,200,000**	**$15,936,500,000**	**USD$**

F3. TAKE-OFF PHASE – HYBRID PER CYCLE

	SCENARIO					UNIT/COMMENT
CAPITAL INPUTS <	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCTION TARGET PER TEAM (tCO_2e)	50,000	25,000	16,667	12,500	10,000	50 $MtCO_2e$ TOTAL PER CYCLE
HUMAN CAPITAL						
NUMBER OF TEAMS	1,000	2,000	3,000	4,000	5,000	TEAMS
SECRETARIAT	5,000	10,000	15,000	20,000	25,000	PARTICIPANTS TO FILL SECRETARIAT ROLES AMONGST EACH TEAM (5 PER TEAM)
IN-KIND TIME CONTRIBUTIONS	20,000	40,000	60,000	80,000	100,000	TEAM MEMBERS ABLE TO SELF-FUND THEIR PARTICIPATION (40 MAX PER TEAM)
TEAM MEMBERS ENGAGED	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
PHYSICAL CAPITAL						
BOOTCAMP	50	100	150	200	250	SPACES PROVIDED IN-KIND FOR STARTUP BOOTCAMP
WORKSPACE	500	1000	1500	2000	2500	WORKSPACES PROVIDED IN-KIND FOR THE TEAMS TO USE AND WORK FROM FOR THE DURATION OF THE CYCLE
SOCIAL CAPITAL						
EXISTING RELATIONSHIPS AMONGST TEAM MEMBERS	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
INTELLECTUAL CAPITAL						
10-IN-10 FUND PROCESS	1	1	1	1	1	
FINANCIAL CAPITAL						
OPERATIONAL COSTS	$718,650,000	$1,437,300,000	$2,155,950,000	$2,874,600,000	$3,593,250,000	USD$
PROTOTYPE FUND (APPROX ORDER OF MAGNITUDE)	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	USD$
TOTAL FINANCIAL CAPITAL REQ.	**$5,093,650,000**	**$5,812,300,000**	**$6,530,950,000**	**$7,249,600,000**	**$7,968,250,000**	**USD$**

CAPITAL OUTPUTS >	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCED BY PER TEAM (tCO_2e)	50,000	25,000	16,667	12,500	10,000	50 $MtCO_2e$ TOTAL PER CYCLE
HUMAN CAPITAL						
TEAMS	1,000	2,000	3,000	4,000	5,000	FUNCTIONAL TEAMS BUILT
JOBS CREATED	25,000	50,000	75,000	100,000	125,000	PEOPLE EMPLOYED DIRECTLY BY THE GIGATONNE FUND (LAB TEAMS - IN-KIND TIME CONTRIBUTIONS)

INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES	45,000	90,000	135,000	180,000	225,000	PEOPLE WITH INCREASED CAPACITY AND SKILLS. 45 PEOPLE PER TEAM.
PHYSICAL CAPITAL						
PROTOTYPES TESTED	5,000	10,000	15,000	20,000	25,000	PROTOTYPES TESTED - 5 X PER TEAM PER CYCLE
SOCIAL CAPITAL						
NEW RELATIONSHIPS AND TRUST IN THE SYSTEM	455,000	910,000	1,365,000	1,820,000	2,275,000	NEW RELATIONSHIPS (EACH TEAM ASKED TO ENGAGE WITH MIN. 500 PEOPLE IN THEIR SYSTEM) MINUS TEAM MEMBERS WHO ARE PAID TO BE INVOLVED
INTELLECTUAL CAPITAL						
THE GIGATONNE PROTOCOL	V2.0	V2.0	V2.0	V2.0	V2.0	
FINANCIAL CAPITAL						
MARKETPLACE	V2.0	V2.0	V2.0	V2.0	V2.0	
FUNDS DISPERSED INTO SYSTEM	$718,650,000	$1,437,300,000	$2,155,950,000	$2,874,600,000	$3,593,250,000	USD$
FUNDS PER PROTOTYPE	$875,000	$437,500	$291,667	$218,750	$175,000	
FUNDS DIRECTLY SPENT ON PROTOTYPES	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	USD$
TOTAL FINANCIAL CAPITAL DISBURSED	**$5,093,650,000**	**$5,812,300,000**	**$6,530,950,000**	**$7,249,600,000**	**$7,968,250,000**	**USD$**

F4. TAKE-OFF PHASE – NON-FINANCIAL PER CYCLE

	SCENARIO					UNIT/COMMENT
CAPITAL INPUTS <	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCTION TARGET PER TEAM (tCO_2e)	50,000	25,000	16,667	12,500	10,000	50 $MtCO_2e$ TOTAL PER CYCLE
HUMAN CAPITAL						
NUMBER OF TEAMS	1,000	2,000	3,000	4,000	5,000	TEAMS
SECRETARIAT	5,000	10,000	15,000	20,000	25,000	PARTICIPANTS TO FILL SECRETARIAT ROLES AMONGST EACH TEAM (5 PER TEAM)
IN-KIND TIME CONTRIBUTIONS	38,000	76,000	114,000	152,000	190,000	TEAM MEMBERS ABLE TO SELF-FUND THEIR PARTICIPATION (40 MAX PER TEAM)
TEAM MEMBERS ENGAGED	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
PHYSICAL CAPITAL						
BOOTCAMP	95	190	285	380	475	SPACES PROVIDED IN-KIND FOR STARTUP BOOTCAMP
WORKSPACE	950	1900	2850	3800	4750	WORKSPACES PROVIDED IN-KIND FOR THE TEAMS TO USE AND WORK FROM FOR THE DURATION OF THE CYCLE
SOCIAL CAPITAL						
EXISTING RELATIONSHIPS AMONGST TEAM MEMBERS	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
INTELLECTUAL CAPITAL						
10-IN-10 FUND PROCESS	1	1	1	1	1	
FINANCIAL CAPITAL						
OPERATIONAL COSTS	$71,865,000	$143,730,000	$215,595,000	$287,460,000	$359,325,000	USD$
PROTOTYPE FUND (APPROX ORDER OF MAGNITUDE)	$437,500,000	$437,500,000	$437,500,000	$437,500,000	$437,500,000	USD$
TOTAL FINANCIAL CAPITAL REQ.	**$509,365,000**	**$581,230,000**	**$653,095,000**	**$724,960,000**	**$796,825,000**	**USD$**

CAPITAL OUTPUTS >	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCED BY PER TEAM (tCO_2e)	50,000	25,000	16,667	12,500	10,000	50 $MtCO_2e$ TOTAL PER CYCLE
HUMAN CAPITAL						
TEAMS	1,000	2,000	3,000	4,000	5,000	FUNCTIONAL TEAMS BUILT
JOBS CREATED	7,000	14,000	21,000	28,000	35,000	PEOPLE EMPLOYED DIRECTLY BY THE GIGATONNE FUND (LAB TEAMS - IN-KIND TIME CONTRIBUTIONS)

INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES	45,000	90,000	135,000	180,000	225,000	PEOPLE WITH INCREASED CAPACITY AND SKILLS. 45 PEOPLE PER TEAM.
PHYSICAL CAPITAL						
PROTOTYPES TESTED	5,000	10,000	15,000	20,000	25,000	PROTOTYPES TESTED - 5 X PER TEAM PER CYCLE
SOCIAL CAPITAL						
NEW RELATIONSHIPS AND TRUST IN THE SYSTEM	455,000	910,000	1,365,000	1,820,000	2,275,000	NEW RELATIONSHIPS (EACH TEAM ASKED TO ENGAGE WITH MIN. 500 PEOPLE IN THEIR SYSTEM) MINUS TEAM MEMBERS WHO ARE PAID TO BE INVOLVED
INTELLECTUAL CAPITAL						
THE GIGATONNE PROTOCOL	V2.0	V2.0	V2.0	V2.0	V2.0	
FINANCIAL CAPITAL						
MARKETPLACE	V2.0	V2.0	V2.0	V2.0	V2.0	
FUNDS DISPERSED INTO SYSTEM	$71,865,000	$143,730,000	$215,595,000	$287,460,000	$359,325,000	USD$
FUNDS PER PROTOTYPE	$87,500	$43,750	$29,167	$21,875	$17,500	
FUNDS DIRECTLY SPENT ON PROTOTYPES	$437,500,000	$437,500,000	$437,500,000	$437,500,000	$437,500,000	USD$
TOTAL FINANCIAL CAPITAL DISBURSED	**$509,365,000**	**$581,230,000**	**$653,095,000**	**$724,960,000**	**$796,825,000**	**USD$**

F5. TAKE-OFF PHASE – ABATEMENT EQUIVALENCIES

		ALPHA	BETA	GAMMA	DELTA	EPSILON
TONNES OF CO_2e PER PROTOTYPE		20,000	10,000	6,667	5,000	4,000
EMISSIONS FROM	PER TONNE OF CO_2e					
CARS DRIVEN FOR 1 YEAR	0.21	4,240	2,120	1,413	1,060	848
POUNDS OF COAL	1,093.00	21,860,000	10,930,000	7,286,667	5,465,000	4,372,000
GALLONS OF GASOLINE	113.00	2,260,000	1,130,000	753,333	565,000	452,000
HOMES ENERGY USE FOR 1 YEAR	0.12	2,400	1,200	800	600	480
BARRELS OF OIL	2.30	46,000	23,000	15,333	11,500	9,200
SMARTPHONES CHARGED	127,512.00	2,550,240,000	1,275,120,000	850,080,000	637,560,000	510,048,000
EMISSIONS AVOIDED BY						
GARBAGE TRUCKS OF WASTE RECYCLED INSTEAD OF LANDFILLED	0.05	1,000	500	333	250	200
INCANDESCENT LAMPS SWITCHED TO LEDS	38.00	760,000	380,000	253,333	190,000	152,000
WIND TURBINES RUNNING FOR 1 YEAR	0.0002	4	2	1	1	1
CARBON SEQUESTERED BY						
TREE SEEDLINGS GROWN FOR 10 YEARS	16.50	330,000	165,000	110,000	82,500	66,000

		ALPHA	BETA	GAMMA	DELTA	EPSILON
TONNES OF CO_2e PER TEAM		100,000	50,000	33,333	25,000	20,000
EMISSIONS FROM	PER TONNE OF CO_2e					
CARS DRIVEN FOR 1 YEAR	0.21	21,200	10,600	7,067	5,300	4,240
POUNDS OF COAL	1,093.00	109,300,000	54,650,000	36,433,333	27,325,000	21,860,000
GALLONS OF GASOLINE	113.00	11,300,000	5,650,000	3,766,667	2,825,000	2,260,000
HOMES ENERGY USE FOR 1 YEAR	0.12	12,000	6,000	4,000	3,000	2,400
BARRELS OF OIL	2.30	230,000	115,000	76,667	57,500	46,000
SMARTPHONES CHARGED	127,512.00	12,751,200,000	6,375,600,000	4,250,400,000	3,187,800,000	2,550,240,000
EMISSIONS AVOIDED BY						
GARBAGE TRUCKS OF WASTE RECYCLED INSTEAD OF LANDFILLED	0.05	5,000	2,500	1,667	1,250	1,000
INCANDESCENT LAMPS SWITCHED TO LEDS	38.00	3,800,000	1,900,000	1,266,667	950,000	760,000
WIND TURBINES RUNNING FOR 1 YEAR	0.00	20	10	7	5	4
CARBON SEQUESTERED BY						
TREE SEEDLINGS GROWN FOR 10 YEARS	16.50	1,650,000	825,000	550,000	412,500	330,000

Source: `https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator`

F6. END-STATE PHASE – PURE FINANCIAL PER CYCLE

	SCENARIO					UNIT/COMMENT
CAPITAL INPUTS <	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCTION TARGET PER TEAM (tCO_2e)	500,000	250,000	166,667	125,000	100,000	500 $MtCO_2e$ (0.5Gt) TOTAL PER CYCLE
HUMAN CAPITAL						
NUMBER OF TEAMS	1,000	2,000	3,000	4,000	5,000	TEAMS
SECRETARIAT	5,000	10,000	15,000	20,000	25,000	PARTICIPANTS TO FILL SECRETARIAT ROLES AMONGST EACH TEAM (5 PER TEAM)
IN-KIND TIME CONTRIBUTIONS	0	0	0	0	0	TEAM MEMBERS ABLE TO SELF-FUND THEIR PARTICIPATION (40 MAX PER TEAM)
TEAM MEMBERS ENGAGED	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
PHYSICAL CAPITAL						
BOOTCAMP	0	0	0	0	0	SPACES PROVIDED IN-KIND FOR STARTUP BOOTCAMP
WORKSPACE	0	0	0	0	0	WORKSPACES PROVIDED IN-KIND FOR THE TEAMS TO USE AND WORK FROM FOR THE DURATION OF THE CYCLE
SOCIAL CAPITAL						
EXISTING RELATIONSHIPS AMONGST TEAM MEMBERS	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
INTELLECTUAL CAPITAL						
10-IN-10 FUND PROCESS	1	1	1	1	1	
FINANCIAL CAPITAL						
OPERATIONAL COSTS	$1,437,300,000	$2,874,600,000	$4,311,900,000	$5,749,200,000	$7,186,500,000	USD$
PROTOTYPE FUND (APPROX ORDER OF MAGNITUDE)	$87,500,000,000	$87,500,000,000	$87,500,000,000	$87,500,000,000	$87,500,000,000	USD$
TOTAL FINANCIAL CAPITAL REQ.	**$88,937,300,000**	**$90,374,600,000**	**$91,811,900,000**	**$93,249,200,000**	**$94,686,500,000**	**USD$**

CAPITAL OUTPUTS >	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCED BY PER TEAM (tCO_2e)	500,000	250,000	166,667	125,000	100,000	500 $MtCO_2e$ (0.5Gt) TOTAL PER CYCLE
HUMAN CAPITAL						
TEAMS	1,000	2,000	3,000	4,000	5,000	FUNCTIONAL TEAMS BUILT

JOBS CREATED	45,000	90,000	135,000	180,000	225,000	PEOPLE EMPLOYED DIRECTLY BY THE GIGATONNE FUND (LAB TEAMS - IN-KIND TIME CONTRIBUTIONS)
INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES	45,000	90,000	135,000	180,000	225,000	PEOPLE WITH INCREASED CAPACITY AND SKILLS. 45 PEOPLE PER TEAM.
PHYSICAL CAPITAL						
PROTOTYPES TESTED	5,000	10,000	15,000	20,000	25,000	PROTOTYPES TESTED - 5 X PER TEAM PER CYCLE
SOCIAL CAPITAL						
NEW RELATIONSHIPS AND TRUST IN THE SYSTEM	455,000	910,000	1,365,000	1,820,000	2,275,000	NEW RELATIONSHIPS (EACH TEAM ASKED TO ENGAGE WITH MIN. 500 PEOPLE IN THEIR SYSTEM) MINUS TEAM MEMBERS WHO ARE PAID TO BE INVOLVED
INTELLECTUAL CAPITAL						
THE GIGATONNE PROTOCOL	V3.0	V3.0	V3.0	V3.0	V3.0	
FINANCIAL CAPITAL						
MARKETPLACE	V3.0	V3.0	V3.0	V3.0	V3.0	
FUNDS DISPERSED INTO SYSTEM	$1,437,300,000	$2,874,600,000	$4,311,900,000	$5,749,200,000	$7,186,500,000	USD$
FUNDS PER PROTOTYPE	$17,500,000	$8,750,000	$5,833,333	$4,375,000	$3,500,000	
FUNDS DIRECTLY SPENT ON PROTOTYPES	$87,500,000,000	$87,500,000,000	$87,500,000,000	$87,500,000,000	$87,500,000,000	USD$
TOTAL FINANCIAL CAPITAL DISBURSED	**$88,937,300,000**	**$90,374,600,000**	**$91,811,900,000**	**$93,249,200,000**	**$94,686,500,000**	**USD$**

F7. END-STATE PHASE – HYBRID PER CYCLE

	SCENARIO					UNIT/COMMENT
CAPITAL INPUTS <	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCTION TARGET PER TEAM (tCO_2e)	500,000	250,000	166,667	125,000	100,000	500 $MtCO_2e$ (0.5Gt) TOTAL PER CYCLE
HUMAN CAPITAL						
NUMBER OF TEAMS	1,000	2,000	3,000	4,000	5,000	TEAMS
SECRETARIAT	5,000	10,000	15,000	20,000	25,000	PARTICIPANTS TO FILL SECRETARIAT ROLES AMONGST EACH TEAM (5 PER TEAM)
IN-KIND TIME CONTRIBUTIONS	20,000	40,000	60,000	80,000	100,000	TEAM MEMBERS ABLE TO SELF-FUND THEIR PARTICIPATION (40 MAX PER TEAM)
TEAM MEMBERS ENGAGED	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
PHYSICAL CAPITAL						
BOOTCAMP	50	100	150	200	250	SPACES PROVIDED IN-KIND FOR STARTUP BOOTCAMP
WORKSPACE	500	1000	1500	2000	2500	WORKSPACES PROVIDED IN-KIND FOR THE TEAMS TO USE AND WORK FROM FOR THE DURATION OF THE CYCLE
SOCIAL CAPITAL						
EXISTING RELATIONSHIPS AMONGST TEAM MEMBERS	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
INTELLECTUAL CAPITAL						
10-IN-10 FUND PROCESS	1	1	1	1	1	
FINANCIAL CAPITAL						
OPERATIONAL COSTS	$718,650,000	$1,437,300,000	$2,155,950,000	$2,874,600,000	$3,593,250,000	USD$
PROTOTYPE FUND (APPROX ORDER OF MAGNITUDE)	$43,750,000,000	$43,750,000,000	$43,750,000,000	$43,750,000,000	$43,750,000,000	USD$
TOTAL FINANCIAL CAPITAL REQ.	**$44,468,650,000**	**$45,187,300,000**	**$45,905,950,000**	**$46,624,600,000**	**$47,343,250,000**	**USD$**

CAPITAL OUTPUTS >	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCED BY PER TEAM (tCO_2e)	500,000	250,000	166,667	125,000	100,000	500 $MtCO_2e$ (0.5Gt) TOTAL PER CYCLE
HUMAN CAPITAL						
TEAMS	1,000	2,000	3,000	4,000	5,000	FUNCTIONAL TEAMS BUILT

JOBS CREATED	25,000	50,000	75,000	100,000	125,000	PEOPLE EMPLOYED DIRECTLY BY THE GIGATONNE FUND (LAB TEAMS - IN-KIND TIME CONTRIBUTIONS)
INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES	45,000	90,000	135,000	180,000	225,000	PEOPLE WITH INCREASED CAPACITY AND SKILLS. 45 PEOPLE PER TEAM.
PHYSICAL CAPITAL						
PROTOTYPES TESTED	5,000	10,000	15,000	20,000	25,000	PROTOTYPES TESTED - 5 X PER TEAM PER CYCLE
SOCIAL CAPITAL						
NEW RELATIONSHIPS AND TRUST IN THE SYSTEM	455,000	910,000	1,365,000	1,820,000	2,275,000	NEW RELATIONSHIPS (EACH TEAM ASKED TO ENGAGE WITH MIN. 500 PEOPLE IN THEIR SYSTEM) MINUS TEAM MEMBERS WHO ARE PAID TO BE INVOLVED
INTELLECTUAL CAPITAL						
THE GIGATONNE PROTOCOL	V3.0	V3.0	V3.0	V3.0	V3.0	
FINANCIAL CAPITAL						
MARKETPLACE	V3.0	V3.0	V3.0	V3.0	V3.0	
FUNDS DISPERSED INTO SYSTEM	$718,650,000	$1,437,300,000	$2,155,950,000	$2,874,600,000	$3,593,250,000	USD$
FUNDS PER PROTOTYPE	$8,750,000	$4,375,000	$2,916,667	$2,187,500	$1,750,000	
FUNDS DIRECTLY SPENT ON PROTOTYPES	$43,750,000,000	$43,750,000,000	$43,750,000,000	$43,750,000,000	$43,750,000,000	USD$
TOTAL FINANCIAL CAPITAL DISBURSED	**$44,468,650,000**	**$45,187,300,000**	**$45,905,950,000**	**$46,624,600,000**	**$47,343,250,000**	**USD$**

F8. END-STATE PHASE – NON-FINANCIAL PER CYCLE

	SCENARIO					UNIT/COMMENT
CAPITAL INPUTS <	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCTION TARGET PER TEAM (tCO_2e)	500,000	250,000	166,667	125,000	100,000	500 MtCO_2e (0.5Gt) TOTAL PER CYCLE
HUMAN CAPITAL						
NUMBER OF TEAMS	1,000	2,000	3,000	4,000	5,000	TEAMS
SECRETARIAT	5,000	10,000	15,000	20,000	25,000	PARTICIPANTS TO FILL SECRETARIAT ROLES AMONGST EACH TEAM (5 PER TEAM)
IN-KIND TIME CONTRIBUTIONS	38,000	76,000	114,000	152,000	190,000	TEAM MEMBERS ABLE TO SELF-FUND THEIR PARTICIPATION (40 MAX PER TEAM)
TEAM MEMBERS ENGAGED	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
PHYSICAL CAPITAL						
BOOTCAMP	95	190	285	380	475	SPACES PROVIDED IN-KIND FOR STARTUP BOOTCAMP
WORKSPACE	950	1900	2850	3800	4750	WORKSPACES PROVIDED IN-KIND FOR THE TEAMS TO USE AND WORK FROM FOR THE DURATION OF THE CYCLE
SOCIAL CAPITAL						
EXISTING RELATIONSHIPS AMONGST TEAM MEMBERS	45,000	90,000	135,000	180,000	225,000	ASSUMES 45 PER TEAM
INTELLECTUAL CAPITAL						
10-IN-10 FUND PROCESS	1	1	1	1	1	
FINANCIAL CAPITAL						
OPERATIONAL COSTS	$71,865,000	$143,730,000	$215,595,000	$287,460,000	$359,325,000	USD$
PROTOTYPE FUND (APPROX ORDER OF MAGNITUDE)	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	USD$
TOTAL FINANCIAL CAPITAL REQ.	**$4,446,865,000**	**$4,518,730,000**	**$4,590,595,000**	**$4,662,460,000**	**$4,734,325,000**	**USD$**

CAPITAL OUTPUTS >	**ALPHA**	**BETA**	**GAMMA**	**DELTA**	**EPSILON**	
NATURAL CAPITAL						
EMISSIONS REDUCED BY PER TEAM (tCO_2e)	500,000	250,000	166,667	125,000	100,000	500 MtCO_2e (0.5Gt) TOTAL PER CYCLE
HUMAN CAPITAL						
TEAMS	1,000	2,000	3,000	4,000	5,000	FUNCTIONAL TEAMS BUILT
JOBS CREATED	7,000	14,000	21,000	28,000	35,000	PEOPLE EMPLOYED DIRECTLY BY THE GIGATONNE FUND (LAB TEAMS - IN-KIND TIME CONTRIBUTIONS)

INCREASED CAPACITIES TO ADDRESS CLIMATE CHALLENGES	45,000	90,000	135,000	180,000	225,000	PEOPLE WITH INCREASED CAPACITY AND SKILLS. 45 PEOPLE PER TEAM.
PHYSICAL CAPITAL						
PROTOTYPES TESTED	5,000	10,000	15,000	20,000	25,000	PROTOTYPES TESTED - 5 X PER TEAM PER CYCLE
SOCIAL CAPITAL						
NEW RELATIONSHIPS AND TRUST IN THE SYSTEM	455,000	910,000	1,365,000	1,820,000	2,275,000	NEW RELATIONSHIPS (EACH TEAM ASKED TO ENGAGE WITH MIN. 500 PEOPLE IN THEIR SYSTEM) MINUS TEAM MEMBERS WHO ARE PAID TO BE INVOLVED
INTELLECTUAL CAPITAL						
THE GIGATONNE PROTOCOL	V3.0	V3.0	V3.0	V3.0	V3.0	
FINANCIAL CAPITAL						
MARKETPLACE	V3.0	V3.0	V3.0	V3.0	V3.0	
FUNDS DISPERSED INTO SYSTEM	$71,865,000	$143,730,000	$215,595,000	$287,460,000	$359,325,000	USD$
FUNDS PER PROTOTYPE	$875,000	$437,500	$291,667	$218,750	$175,000	
FUNDS DIRECTLY SPENT ON PROTOTYPES	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	$4,375,000,000	USD$
TOTAL FINANCIAL CAPITAL DISBURSED	**$4,446,865,000**	**$4,518,730,000**	**$4,590,595,000**	**$4,662,460,000**	**$4,734,325,000**	**USD$**

F9. END-STATE PHASE – ABATMENT EQUIVALENCIES

		ALPHA	BETA	GAMMA	DELTA	EPSILON
TONNES OF CO_2e PER PROTOTYPE		200,000	100,000	66,667	50,000	40,000
EMISSIONS FROM	PER TONNE OF CO_2e					
CARS DRIVEN FOR 1 YEAR	0.21	42,400	21,200	14,133	10,600	8,480
POUNDS OF COAL	1,093.00	218,600,000	109,300,000	72,866,667	54,650,000	43,720,000
GALLONS OF GASOLINE	113.00	22,600,000	11,300,000	7,533,333	5,650,000	4,520,000
HOMES ENERGY USE FOR 1 YEAR	0.12	24,000	12,000	8,000	6,000	4,800
BARRELS OF OIL	2.30	460,000	230,000	153,333	115,000	92,000
SMARTPHONES CHARGED	127,512.00	25,502,400,000	12,751,200,000	8,500,800,000	6,375,600,000	5,100,480,000
EMISSIONS AVOIDED BY						
GARBAGE TRUCKS OF WASTE RECYCLED INSTEAD OF LANDFILLED	0.05	10,000	5,000	3,333	2,500	2,000
INCANDESCENT LAMPS SWITCHED TO LEDS	38.00	7,600,000	3,800,000	2,533,333	1,900,000	1,520,000
WIND TURBINES RUNNING FOR 1 YEAR	0.0002	40	20	13	10	8
CARBON SEQUESTERED BY						
TREE SEEDLINGS GROWN FOR 10 YEARS	16.50	3,300,000	1,650,000	1,100,000	825,000	660,000

		ALPHA	BETA	GAMMA	DELTA	EPSILON
TONNES OF CO_2e PER TEAM		1,000,000	500,000	333,333	250,000	200,000
EMISSIONS FROM	PER TONNE OF CO_2e					
CARS DRIVEN FOR 1 YEAR	0.21	212,000	106,000	70,667	53,000	42,400
POUNDS OF COAL	1,093.00	1,093,000,000	546,500,000	364,333,333	273,250,000	218,600,000
GALLONS OF GASOLINE	113.00	113,000,000	56,500,000	37,666,667	28,250,000	22,600,000
HOMES ENERGY USE FOR 1 YEAR	0.12	120,000	60,000	40,000	30,000	24,000
BARRELS OF OIL	2.30	2,300,000	1,150,000	766,667	575,000	460,000
SMARTPHONES CHARGED	127,512.00	127,512,000,000	63,756,000,000	42,504,000,000	31,878,000,000	25,502,400,000
EMISSIONS AVOIDED BY						
GARBAGE TRUCKS OF WASTE RECYCLED INSTEAD OF LANDFILLED	0.05	50,000	25,000	16,667	12,500	10,000
INCANDESCENT LAMPS SWITCHED TO LEDS	38.00	38,000,000	19,000,000	12,666,667	9,500,000	7,600,000
WIND TURBINES RUNNING FOR 1 YEAR	0.00	200	100	67	50	40
CARBON SEQUESTERED BY						
TREE SEEDLINGS GROWN FOR 10 YEARS	16.50	16,500,000	8,250,000	5,500,000	4,125,000	3,300,000

Source: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

G. EXAMPLES OF CITIES THAT MEET CONDITIONS FOR HOSTING GIGATONNE TEAMS

THE GIGATONNE STRATEGY has a geographic focus on cities given the vast opportunities for emissions abatement they provide and their historical leadership on climate issues.

See 3.4.1.4 Strategic Direction

We aim to set up Gigatonne Teams in cities with over 1 million people. The list below shows a selection of cities that meet this condition and have shown leadership as members of the C40 Cities Climate Leadership Group. Other criteria can be used to select partner cities, for example having made a commitment to reach net-zero before 2050 or having ambitious annual abatement targets.

CITY	COUNTRY	POPULATION	FOOTPRINT/ CAPITA (t CO_2)[55]	NET ZERO YEAR	ESTIMATED AVERAGE ANNUAL ABATEMENT REQUIRED TO MEET CURRENT GOALS (t CO_2)
BUENOS AIRES	ARGENTINA	2,890,151	4.1		254,850
MELBOURNE	AUSTRALIA	4,936,000	13.9	2050	285,184
DHAKA	BANGLADESH	8,906,000	0.7		
RIO DE JANEIRO	BRAZIL	6,520,266	1.8	2065	
CURITIBA	BRAZIL	1,765,000	3.5		
SALVADOR	BRAZIL	6,378,000			
SÃO PAULO	BRAZIL	12,180,000			1,512
TORONTO	CANADA	2,731,571	9.7		
MONTREAL	CANADA	1,942,044	10.1		
SANTIAGO	CHILE	5,614,000	4.4		
GUANGZHOU	CHINA	13,000,000	6.1		
SHANGHAI	CHINA	24,240,000	7.6		
BEIJING	CHINA	21,540,000	4.2		
WUHAN	CHINA	11,080,000	7.0		
NANJING	CHINA	8,335,000	7.1		
CHENGDU	CHINA	7,800,000	4.4		
DALIAN	CHINA	6,170,000	9.4		
SHENZHEN	CHINA	12,530,000			
HONG KONG	CHINA, HONG KONG SPECIAL ADMINISTRATIVE REGION	7,391,700			

55. D Moran et al. "Carbon footprints of 13,000 cities," *Environmental Research Letters* (2018) DOI: 10.1088/1748-9326/aac72a.

BOGOTÁ	COLOMBIA	8,081,000			203,491
MEDELLÍN	COLOMBIA	2,508,000			
QUITO	ECUADOR	1,619,000	4.2		
CAIRO	EGYPT	9,500,000			
ADDIS ABABA	ETHIOPIA	3,384,569			
PARIS	FRANCE	2,265,886	7.7	2050	739,217
BERLIN	GERMANY	3,575,000	10.4		
ACCRA	GHANA	1,594,000			
NEW DELHI	INDIA	21,750,000	2.6		
KOLKATA	INDIA	4,497,000	1.7		
MUMBAI	INDIA	18,410,000	1.5		
CHENNAI	INDIA	7,088,000	2.3		
BENGALURU	INDIA	8,426,000			
JAKARTA	INDONESIA	10,075,310	2.3		578
MILAN	ITALY	1,352,000	8.0		
ROME	ITALY	2,873,000	6.7		
TOKYO	JAPAN	13,857,664			1,332,857
YOKOHAMA	JAPAN	3,731,096			361,667
AMMAN	JORDAN	4,008,000	4.0		
NAIROBI	KENYA	3,134,000			
KUALA LUMPUR	MALAYSIA	1,808,000			
MEXICO CITY	MEXICO	8,833,416	2.8		165,179
AUCKLAND	NEW ZEALAND	1,657,200	6.8		111,150
LAGOS	NIGERIA	17,500,000	0.5		
KARACHI	PAKISTAN	14,910,000	0.7		
LIMA	PERU	10,000,000	2.6		
QUEZON CITY	PHILIPPINES	2,936,000			
WARSAW	POLAND	1,758,143	7.5		287,844
MOSCOW	RUSSIA	11,920,000	6.9		
DAKAR	SENEGAL	1,056,000			
SINGAPORE	SINGAPORE	5,610,000	30.8		
CAPE TOWN	SOUTH AFRICA	4,174,510	7.7		401,624
DURBAN	SOUTH AFRICA	595,061,000	8.4		
TSHWANE	SOUTH AFRICA	3,442,361			
MADRID	SPAIN	3,174,000	8.8		
BARCELONA	SPAIN	1,604,555	7.1	2050	152,466
DAR ES SALAAM	TANZANIA	4,365,000			
BANGKOK	THAILAND	8,281,000			
ISTANBUL	TURKEY	15,070,000	5.2		

DUBAI	UNITED ARAB EMIRATES	3,137,000	22.3		
LONDON	UNITED KINGDOM	8,883,800	10.4	2050	1,407,813
LOS ANGELES	USA	4,000,000	14.6	2050	
HOUSTON	USA	2,313,000	14.6		
CHICAGO	USA	2,714,017	21.1		479,303
PHILADELPHIA	USA	1,559,938	19.5		737,353
AUSTIN	USA	1,265,974	15.0	2050	361,290
NEW YORK CITY	USA	8,537,673		2050	1,356,889
CARACAS	VENEZUELA	2,082,000	3.6		
HO CHI MINH CITY	VIETNAM	8,993,000	2.3		
HANOI	VIETNAM	8,054,000	2.3		

H. GT TEAM ILLUSTRATIVE EXAMPLE: PUNE, INDIA

TO UNDERSTAND HOW GT teams will be constituted and what sort of work they will do we have created an illustrative example using the city of Pune in India. Pune is the 9th most populous city in India, with a population of ~3.1m (~7.2m in the metropolitan area).

We imagine that Indian Metropolitan Regions with a population of over one million would likely qualify to constitute GT Teams in a similar way. The actual constitution of teams and what prototypes they decide to test will vary from city to city, in that the actual city-based team will make those decisions.

ENERGY CONTEXT

RENEWABLES IN INDIA generate electricity, on average, about 30% of the time, while the figure for coal is about 60%. This is low for coal. The government's target for coal is 80%.

So while renewables made up 18% of total capacity at the end of 2017 – up from 15% the year before – it contributed only 7.5% of generation for the year. (Gas capacity is also misleading: with very constrained supplies, gas-powered stations in India operate at only 20% of capacity.)

PUNE EMISSIONS

A 2012 CARBON inventory by TERI estimated that the city of Pune emits 4.6 million tonnes (4.6 MT) of CO_2e per year.

The estimated per capita average was found to be 1.4 tonnes, lower than the national average.

We can assume that since 2012 emissions have risen. During the launch phase we will establish a new baseline.

The city has a population of 3,124,458; while 5,057,709 people reside in the Pune Urban Agglomeration as of the 2011 census. The latter was c. 4,485,000 in 2005. According to the Pune Municipal Corporation (PMC), 40% of the population lived in slums in 2001.

Of these, 45% slum households do not have in-house toilet facilities and 10% do not have electricity. One third of the slums are on mixed ownership land.

KEY INDUSTRIES

ENGINEERING, MANUFACTURING, IT, EDUCATION

THE KIRLOSKAR GROUP came to Pune in 1945 by setting up Kirloskar Oil Engines, India's largest diesel engine company, at Khadki. The group has several subsidiaries in Pune including Kirloskar Pneumatics and Kirloskar Brothers Limited, one of India's largest manufacturers and exporters of pumps and the largest infrastructure pumping project contractor in Asia.

Automotive companies such as Bajaj Auto, Tata Motors, Mahindra & Mahindra, Mercedes Benz, Force Motors, Kinetic Motors, General Motors, Land Rover, Jaguar, Renault, Volkswagen, and Fiat have set up greenfield facilities near Pune, leading The Independent to describe Pune as India's "Motor City".

According to the Indo-German Chamber of Commerce, Pune has been the single largest hub for German companies for the last 60 years. Over 225 German companies have set up their businesses in Pune. Serum Institute of India, the world's fifth largest vaccine producer by volume, has a manufacturing plant located in Pune. In 2014-15, the manufacturing sector provided employment to over 500,000 people.

Pune has historically been known as a center for higher education and has been referred to as the educational capital of India. In 2006, it was reported that nearly 200,000 students from across India study in Pune at nine universities and more than a hundred educational institutes.

Pune has the eighth largest metropolitan economy and the sixth highest per capita income in the country.

The 2017 Annual Survey of India's City-Systems (ASICS) report, released by the Janaagraha Centre for Citizenship and Democracy, adjudged Pune as the best governed of 23 major cities.

POTENTIAL GT PUNE TEAM

CIVIL SOCIETY	GOVERNMENT	BUSINESS
JIVIDHA	PUNE METROLOGICAL OBSERVATORY AND RESEARCH LABORATORY	KIRLOSKAR GROUP
VASUNDHARA SWACHATA ABHIYAN TRUST	MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA)	TATA MOTORS
ANNADATA	PUNE UNIVERSITY, ENERGY DEPARTMENT	VOLKSWAGEN
VASUNDHARA TRUST	PUNE MUNICIPAL CORPORATION (PMC)	TATA MANAGEMENT TRAINING
ECOLOGICAL SOCIETY	BHAVAN RACHNA (PMC)	INFOSYS
RUDRA	CHIEF ENGINEER (PMC)	MAHINDRA AND MAHINDRA
PRAGATI FOUNDATION	ELECTRICAL DEPARTMENT (PMC)	ULTRA TECH
KALPVIRKSH ENVIORNMENTAL ACTION GROUP	SOLID WASTE MANAGEMENT (PMC)	PRAJ INDUSTRIES
APPLIED ENVIRONMENTAL RESEARCH GROUP	DMC ZONE 1-5 WARD OFFICES (15 WARDS)	MAILHEM
INDIAN NETWORK FOR ETHICS AND CLIMATE CHANGE		FORBES MARSHALL
IOFC INDIA		AGNI SOLAR
TERI		ENRICH ENERGY
		THERMAX
		SWITCH ON ECO SOLUTION AND SERVICES PRIVATE LIMITED
		SAMUCHIT ENVIROTECH
		DELTA PURE

POTENTIAL ENERGY EFFICIENCY PROTOTYPES

THE TARGETS FOR this team in each phase would be as follows. Note in practice these targets will be dynamic, as data comes in from teams, the targets are a function of the number of teams active and their performance. We are therefore using these targets are heuristics to guide us as performance required in each phase until we have real-time performance data.

PHASE/REQUIREMENTS	START-UP	TAKE-OFF	END-STATE
MINIMUM PER TEAM tCO_2e	2,500	10,000	100,000
MAXIMUM PER TEAM tCO_2e	10,000	50,000	500,000
MINIMUM PER PROTOTYPE tCO_2e	500	2000	20,000
MAXIMUM PER PROTOTYPE tCO_2e	2,000	10,000	100,000

Each Operational Cycle is six-months long. In those 6-months, teams will start with a 30-day "stress test" of potential prototypes. The goal of the "stress-test" is to "break" each potential prototype on paper by assessing technical, financial and political feasibility of implementation in the team's specific context. So for example, while retro-fitting buildings might be a great solution on paper, we might find that it's not very feasible in Pune for a number of local contextual factors. A prototype "breaks" if it is not deemed feasible to implement or if it doesn't meet abatement, equity or temporal requirements.

These are examples of potential prototypes a GT Team is Pune can test.

1. BUILDING RETROFITTING / INSULTATION

DRAWDOWN IMPACT SUMMARY:

RETROFITTING BUILDINGS WITH insulation is a cost-effective solution for reducing energy required for heating and cooling. If 54 percent of existing residential and commercial buildings install insulation, 8.3 gigatons of emissions can be avoided at an implementation cost of $3.7 trillion. Over thirty years, net savings could be $2.5 trillion. However, insulation measures can last one hundred years or more, realizing lifetime savings in excess of $4.2 trillion.

2. WASTE DIVERSION / HOUSEHOLD / INDUSTRIAL RECYCLING / COMPOSTING

DRAWDOWN IMPACT SUMMARY:

HOUSEHOLD RECYCLING

THE HOUSEHOLD AND industrial recycling solutions were modeled together and include metals, plastic, glass, and other materials, such as rubber, textiles, and e-waste. Paper products and organic wastes are treated in separate waste management solutions. Emissions reductions stem from avoiding emissions associated with landfilling and from substituting recycled materials for virgin feedstock. With about 50 percent of recycled materials coming from households, if the average worldwide recycling rate increases to 65 percent of total recyclable waste, household recycling could avoid 2.8 gigatons of carbon dioxide emissions by 2050.

INDUSTRIAL RECYCLING

AS MENTIONED ABOVE, household and industrial recycling were modeled together. The total additional implementation cost of both is estimated at $734 billion, with a net operational savings of $142 billion over thirty years. On average, 50 percent of recyclable materials come from industrial and commercial sectors. At a 65 percent recycling rate, the commercial and industrial sectors can avoid 2.8 gigatons of carbon dioxide by 2050.

COMPOSTING

IN 2015, AN estimated 38 percent of food waste was composted in the United States; 57 percent was composted in the European Union. If all lower-income countries reached the U.S. rate and all higher-income countries achieved the E.U. rate, composting could avoid methane emissions from landfills equivalent to 2.3 gigatons of carbon dioxide by 2050. That total excludes additional gains from applying compost to soil. Compost facilities cost less to construct but more to operate, which is reflected in the financial results.

3. ZERO EMISSIONS TRANSPORT CORRIDOR / EV

WE IMAGINE THAT small scale EV tests could be run on the most popular transport routes fairly quickly and easily.

DRAWDOWN IMPACT SUMMARY:

EV

IN 2014, 305,000 EVs were sold. If EV ownership rises to 16 percent of total passenger miles by 2050, 10.8 gigatons of carbon dioxide from fuel combustion could be avoided. Our analysis accounts for emissions from electricity generation and higher emissions of producing EVs compared to internal-combustion cars. We include slightly declining EV prices, expected due to declining battery costs.

4. ROOFTOP SOLAR / SOLAR WATER / LED LIGHTING / LED (COMMERCIAL)

DRAWDOWN IMPACT SUMMARY:

OUR ANALYSIS ASSUMES rooftop solar PV can grow from .4 percent of electricity generation globally to 7 percent by 2050. That growth can avoid 24.6 gigatons of emissions. We assume an implementation cost of $1,883 per kilowatt, dropping to $627 per kilowatt by 2050. Over three decades, the technology could save $3.4 trillion in home energy costs.

SOLAR WATER

If solar water heating grows from 5.5 percent of the addressable market to 25 percent, the technology can deliver emissions reductions of 6.1 gigatons of carbon dioxide and save households $774 billion in energy costs by 2050. In our calculations of up-front costs, we assume solar water heaters supplement and do not replace electric and gas boilers.

LED LIGHTING

Our analysis assumes that LEDs will become ubiquitous by 2050, encompassing 90 percent of the household lighting market. As LEDs replace less-efficient lighting, 7.8 gigatons of carbon dioxide emissions could be avoided in residences. Additional gains, not counted here, will come from replacing off-grid kerosene lighting with solar-LED technology.

Our analysis assumes that LEDs will become ubiquitous by 2050, encompassing 82 percent of commercial lighting. As LEDs replace less-efficient lighting, 5.0 gigatons of carbon dioxide emissions could be avoided in commercial buildings. LED COMMERCIAL

5. SMART MICRO-GRID

USING TECHNOLOGY LIKE RedGrid, we can test building a smart micro-energy grid across the technology parks in Pune.

DRAWDOWN IMPACT SUMMARY:

We model the growth of microgrids in areas that currently do not have access to electricity, using renewable energy alternatives such as in-stream hydro, micro wind, rooftop solar, and biomass energy, paired with distributed energy storage. It is assumed that these systems replace what would otherwise be the extension of a dirty grid or the continued use of off-grid oil or diesel generators. Emissions impacts are accounted for in the individual solutions themselves, preventing double counting. For higher-income countries the benefits of microgrid systems fall under "Grid Flexibility." MICRO GRIDS

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