ARUP

2050 Scenarios

2050 SCENARIOS

This report is a collaboration between Arup's Foresight, Research and Innovation and Sustainable Development teams. We are grateful for the input and advice from a range of contributors.

ABOUT FORESIGHT

Foresight, Research and Innovation is Arup's internal think-tank and consultancy which focuses on the future of the built environment and society at large. We help organisations understand trends, explore new ideas, and radically rethink the future of their businesses. We developed the concept of 'foresight by design', which uses innovative design tools and techniques to bring new ideas to life, and to engage all stakeholders in meaningful conversations about change.

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#2050Scenarios

Released December 2019

ARUP

Contents

"We live in increasingly
uncertain times. For many, this
is a source of fear; for others, it
is a source of inspiration."

Futures context

CHRIS LUEBKEMAN
Arup Fellow and Director
Global Foresight, Research and Innovation

The changes we have witnessed during our lifetimes will pale in comparison to those which lie before us. So, just what might that landscape look like? Scenarios are stories that we tell ourselves about what the future could be. They can be comforting, disconcerting, amusing, appalling, inspirational or perhaps even depressing. We use them to help us prepare for what could be, or perhaps even to consider ways to bend the vectors a bit.

Why are we developing scenarios for 2050 at Arup? We are doing so to gain a deeper understanding and appreciation of the implications, opportunities and threats to, and on, our businesses and markets. These are intended for use by anyone and everyone at Arup, in the industry and globally.

It is now recognised that human systems are putting our planetary systems under significant stress. Thus, we thought it appropriate to consider four worlds in which these two systems would be juxtaposed as the axes. Each of the resulting scenarios are compelling for different reasons: from a world in which both the societal systems and natural systems move towards collapse, to one where sympathetic symbiosis is the baseline for all activities on our planet. We believe that these four worlds are consistent, coherent and plausible. Indeed, there are indications that each can already be found somewhere on Earth.

To help us understand and plan for our communal future, sometimes we must push ourselves to imagine the possible. To think outside of our daily lives, and envision the world as it could be, should be, might be, what we hope it will be and what we hope it won't be. Although future pathways are not clear, we can, and must, move forward with both aspiration and intent. These scenarios should help us to consider how we craft the parameters of that intent. I hope you go on your own journeys and make your own discoveries within them.

Foreword

JO DA SILVA
Arup Fellow and Director
*Global Sustainable Development Leader*

We live in a world characterised by increasing complexity and uncertainty. Climate change, biodiversity loss and resource scarcity threaten future generations and will require urgent global action and collaboration over the next decade. Meanwhile, digital technology, urbanisation and changing demographics will impact communities, businesses and economies, radically affecting every aspect of our lives. The future, 2050 and beyond, will be determined by our ability to address today's environmental challenges and social changes to meet the needs of nearly ten billion people who will be primarily living in urban areas.

We cannot predict the future, but our ability to imagine possible futures can help guide the solutions we create and decisions we make so that our story has a happy ending. To spark our imagination, Arup's Foresight, Research and Innovation team have developed four plausible futures that describe what the world might look like in 2050. These futures hinge on whether we prioritise social and economic development over environmental health, or vice versa.
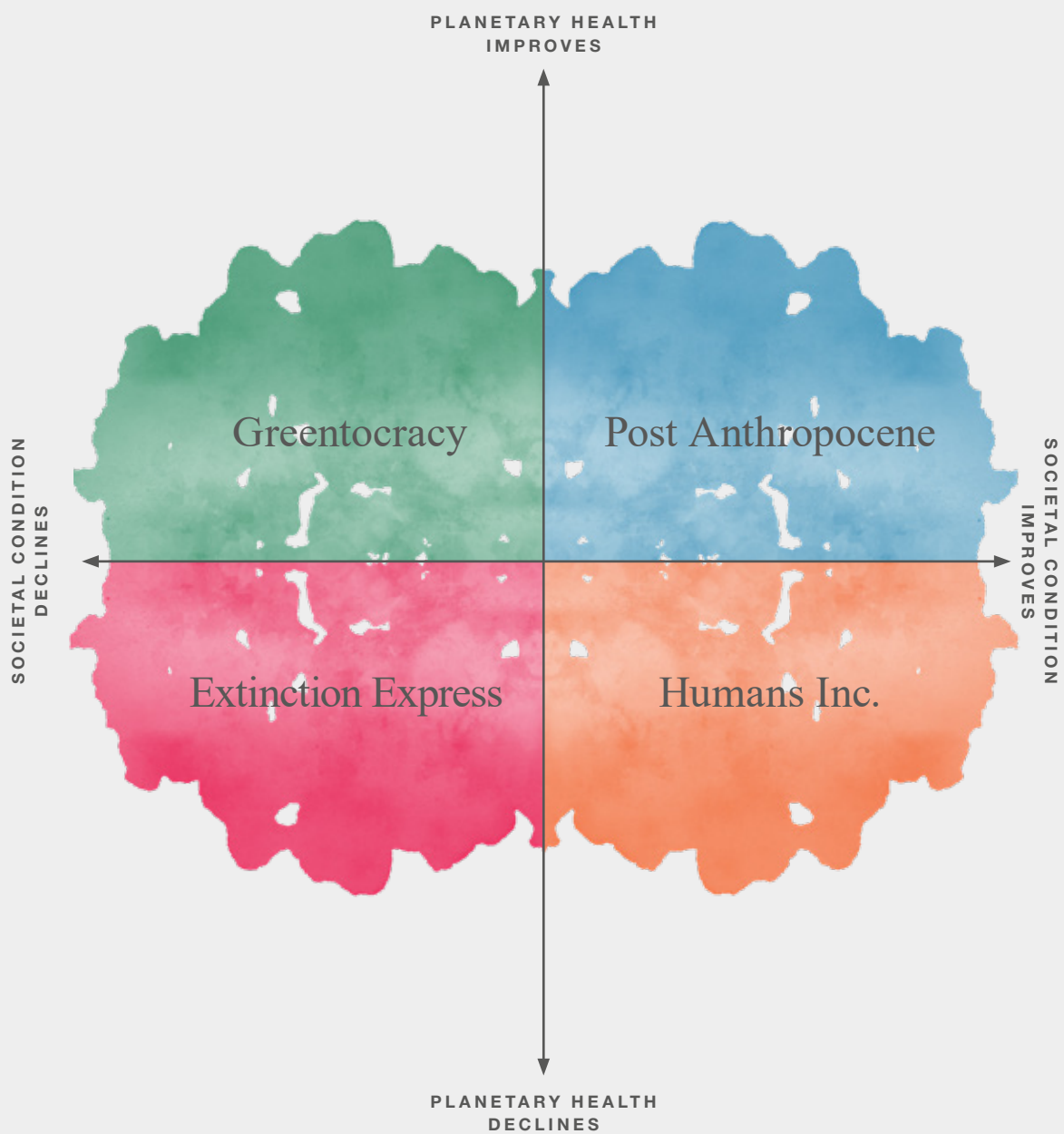
Which aspects of these four scenarios become reality will be determined by the extent to which the world unites behind the United Nations' Sustainable Development Goals. These goals have been described as 'the blueprint to achieve a better and more sustainable future for all.' They are not an end in themselves, but a milestone on our journey to a sustainable future. The decisions we make and actions we take as individuals, businesses and governments over the next decade will determine our trajectory.

We must all work together to shape a better world.
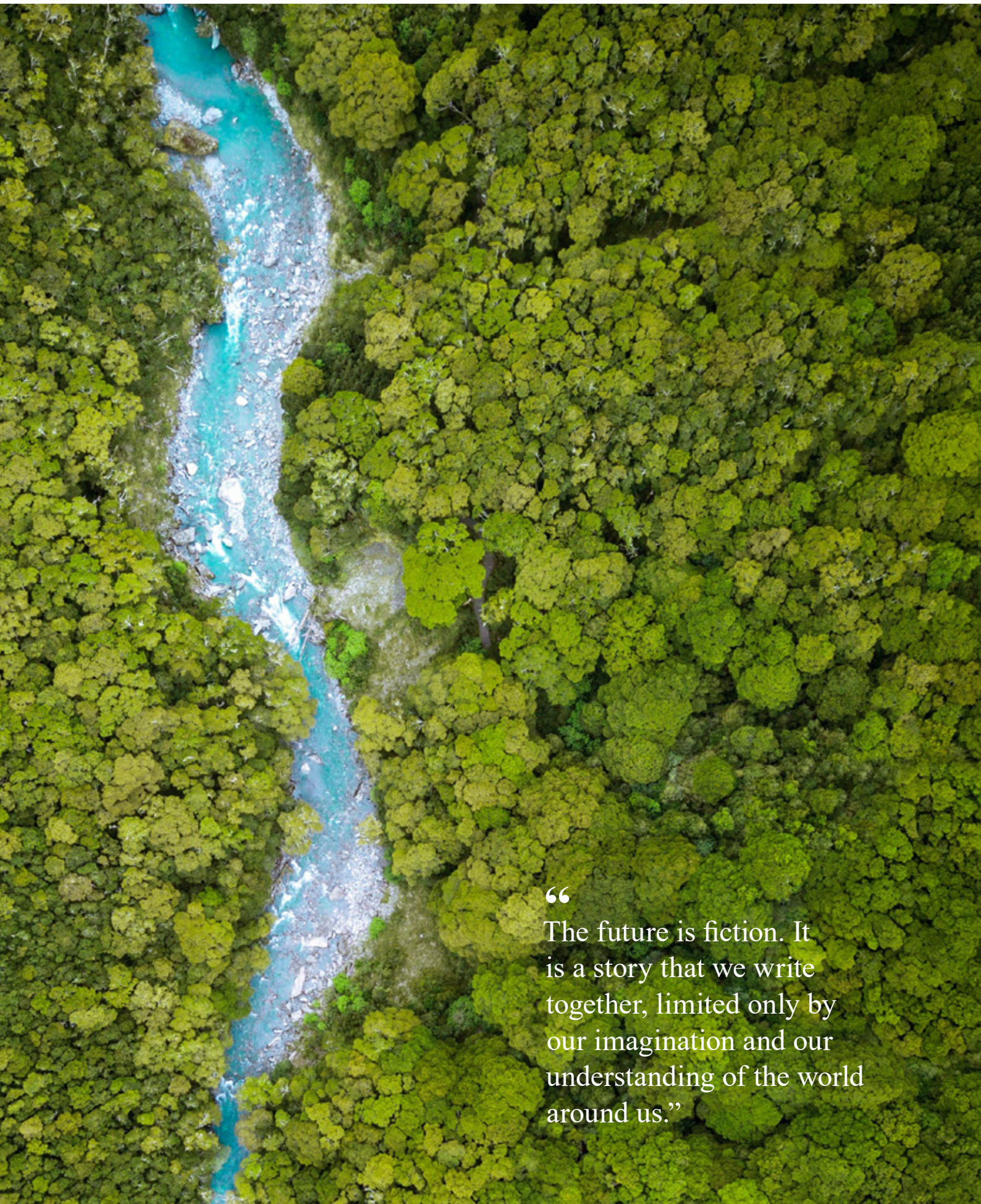
> "
> The future is fiction. It
> is a story that we write
> together, limited only by
> our imagination and our
> understanding of the world
> around us."

PLANETARY HEALTH
IMPROVES

SOCIETAL CONDITION
DECLINES

SOCIETAL CONDITION
IMPROVES

Greentocracy

Post Anthropocene

Extinction Express

Humans Inc.

PLANETARY HEALTH
DECLINES

Executive summary

The world today is marked by rapid change. Some trends point towards human progress, others indicate an increasingly perilous outlook for the planet.

2050 Scenarios: Four plausible futures is intended to develop a vocabulary and framework to help us envision different futures and provide a platform to discuss the implications of the implied trajectories. Ultimately, they help to identify and visualise what is worth striving for and what to avoid.

Arup has developed the scenarios in line with our commitment to shaping a sustainable future and a recognition that the path towards it will be challenging. Radical design solutions will be required. Our approach plots each scenario in relation to two intersecting axes: planetary health and societal condition.

The science-based targets of the nine Planetary Boundaries, Arup's Drivers of Change cards, as well as the United Nations' Sustainable Development Goals (UN SDGs) were used to set parameters and guide the scenario development.

The core narrative of each scenario is accompanied by a story told from the perspective of a person within that world. A timeline of events between today and 2050 describes how each world could come to exist, along with key facts and references. The extent to which each scenario satisfies the 17 UN SDGs is also indicated.

POST ANTHROPOCENE shows how societal conditions and planetary health might exist in a harmonious relationship, fortifying each other for mutual progress and benefit. Taman, a biotech project manager in Jakarta, is finding his place in this balanced world.

GREENTOCRACY describes an improvement in planetary health which has been enabled by severe restrictions on human society: restrictive living conditions, conflict and authoritarian regimes prevail. The accompanying story details the everyday compromises made by Moussa as he heads to work in eastern Senegal.

EXTINCTION EXPRESS depicts both declining planetary health and societal conditions. It is questionable how much longer humanity can survive. Caitlyn, an Oslo-based commodities trader, is shocked into facing the realities of her privileged existence.

HUMANS INC. represents our current trajectory; a world in which societal conditions advance at the cost of planetary health. The accompanying story describes Yuka, a Nunavut native, as she struggles with the changes that have engulfed her once remote home.

Plausible future conditions help to challenge existing biases and assumptions about what is possible, engaging curiosity and imagination. Building and sharing scenarios allow the co-creation of visions of a future worth working towards.

Introduction

It is impossible to know what the world will look like in 2050. Analysing current trends and drivers of change across a variety of industries, sectors, categories and topics can help to characterise different possible futures.

Most global trends indicate an improvement in societal wellbeing; an increase in global life expectancy, GDP and education levels. Simultaneously, other trends depict a more perilous future, particularly regarding our environment: global temperature and sea level rise, an increase in extreme weather events, ocean acidification and tropical forest loss. These trends are often viewed individually and perhaps perceived as being unrelated, yet they interact in complex and often intricate ways.

This document provides a view into of four plausible futures that explore the intersection of planetary health and societal conditions in the year 2050. These were developed in collaboration with Arup colleagues from around the world with backgrounds ranging from geotechnics and urban planning to structural engineering and ecology. The scenarios are neither predictions nor forecasts, but summaries of future worlds.

Our research began with a review of global trends and projections obtained from think tanks, governments, statistical data, NGOs and research institutions. While some trends are presented as inevitable – life expectancy is increasing, the world is expanding its urban footprint, global population is on the rise – other trends, such as frequency of extreme weather events, food security, and income disparity are highly uncertain and subject to variability.

The trends were mapped into a four-square matrix with two axes: planetary health and societal condition. Planetary health measures the condition of Earth's natural systems, including water cycles, forests, oceans, biodiversity and climate change. Societal condition describes the state of humanity, and encompasses factors such as the quality of life, public health, societal structure, governance systems, education, and work.

This matrix was then populated with twenty critical factors that will affect our global future, each with multiple possible trajectories. A working group considered, confirmed and clustered the trajectories along the two axes, setting the baseline for the four scenarios.

The first iteration was the result of a two-day working session. A cross-section of leaders and experts was then brought together to explore and expand these scenarios and to consider the role that the UN SDGs might play. The scenarios were further developed into this set of four narratives, stories, data and timelines.

We hope the scenarios spark your imagination and help you think about the role that all of us can play in designing, building, inhabiting and living in our communal future.

The world of 2050 boasts a balanced biosphere: humanity and 'spaceship Earth' are thriving in harmony.

Post Anthropocene

Both people and planet are on the path to a regenerative world. Society consumes resources at the rate at which they can be replenished, populations are diverse, and societal structures are balanced.

Humanity is well on its way towards a shared consciousness and an understanding of Earth's limited resources – that production and consumption are intrinsically linked to the natural environment. There is no 'away' to throw discarded things. Global ecosystem services are recognised and valued, helping to improve the quality of both planet and society. Circular processing measures are in place and most nations abide by them. Full life-cycle and ecological resource assessments are mandatory for all new products. Global biodiversity loss has halted, and protected areas are seeing ecosystem recovery. Everyone has, and knows, their carbon quota and daily spend; AI provides daily updates, and state governments penalise overspend. The multi-stakeholder vision for an equitable and thriving future has prevailed. All global leaders are proud to wear the 'thriving planet = thriving people' symbol showing their support for the drive towards the post-Anthropocene epoch. Cities around the world have transitioned from being in conflict with nature to something approaching symbiosis.

Science Based Targets (SBTs) for resource use and emissions are well established and are key to today's recovering planet. The 2020s saw technology companies hotly contending for the position of 'green leader' driven by competing aspirations in 'green tech' and philanthropy.

Cross-fertilising innovations in sensing and AI have led to major breakthroughs in planetary health monitoring. Big tech-players had varying motives for participation in the race for a better planet: some saw their position of power as an opportunity to do good, while others saw an opportunity to capitalise on shifting consumer priorities; both paths have led to a brighter present.

Literacy rates have risen dramatically since the 2020s, with nearly 60% of the global population now completing a high school education. Global change and interdisciplinary environmentalism have a strong presence in the curriculum of school systems around the world. The 'green economy' employs a large portion of the population, with public-private partnerships supporting 'planet first' initiatives. Life-Long Learning Accounts for almost every citizen have been set up as part of the global carbon taxation scheme introduced in 2030. These fully-funded upskilling opportunities ensure that the working population is equipped to continue driving innovation and regenerative advancements. Workers are paid a living wage and can pursue jobs that they enjoy and are meaningful. As open borders are expanded and knowledge is willingly shared, individuals have increasing freedom to move around the world. This global pursuit of knowledge and opportunity, unhindered by the geo-political conflicts of the past, is supporting a new era of technological innovation and cultural exploration.

North America experienced the worst widespread mono-culture crop failure with the two-pronged impact of drought and pathogen outbreaks due to the vector change from climate warming in 2025. The Great

Workers are paid a living wage and can pursue jobs that they enjoy and find meaning in.

What was once known as rubbish or garbage is one of today's most valuable resources and is mined both on land and sea. Everything is a resource.

Climate March of 2028 was held in response to food and biofuel price hikes. Although devastating, these events heightened the global debate on how to sustainably feed the growing population and ultimately catalysed action. Advances in agriculture have been developed: both GMOs that require little water, zero pesticides and less land, as well as innovative deep dynamic organic farming. Some praise GMOs and engineered farming for their efforts in eliminating famine events, while others argue that only organic agriculture truly respects the planet. Both approaches have improved biodiversity and soil quality where practiced.

The famines of 2025 and 2026 also affected far more than just diet. It unleashed an interest in personal carbon accounting similar to the 2010s' fascination with daily health and behaviour monitoring which later evolved into predictive medicine. As a result, the cost of carbon is now included in the price of goods and transactions. The 'we-conomy' has also grown, with shared assets now preferred as they enable better utilisation of personal carbon quotas. The resulting shift in industrial practices, transport and consumption patterns has further de-coupled GDP growth from resource consumption.

What was once known as rubbish or garbage is one of today's most valuable resources and is mined both on land and sea. Multinational negotiations for repurposing waste for energy, fashion, manufacturing and fertiliser started in the 2020s. This was the precursor for the 2032 Glocal Garbage Protocol (GGP) which agreed that all countries will use 50% reused materials in all

new production and would repurpose 90% of their new waste. Everything is considered a resource. The GGP cleaned up 95% of the Great Pacific Garbage Patch by 2040, but the microplastics will remain a challenge for some years to come. Artefacts of the era, such as plastic bags, bottles and rubber ducks, were collected and are now on display at The Plastic Patch Museum in Calcutta.

It is acknowledged that progress towards a global consensus and a balanced planet has been hard fought, yet the rewards won by working together – from a stable climate to the miracle of precision medicine – are spurring even greater collaboration.

The Parliament of the Commons was established as an arm of the United Nations (UN) General Assembly bringing voices of the global commons, like our Oceans, Forests, Savannahs and Atmosphere, to the world stage for the first time; each has their own flag flying at the UN. Talks about giving AI a voice started in the 2040s and proved controversial. A healthy debate is ongoing.

9.6bn
global population

low wealth gap

1.3°C
increase

high global
cooperation

stable weather

92%
clean energy

Timeline

2021
LARGE-SCALE CLIMATE CHANGE CONSEQUENCES
15% of Arctic sea ice has melted (since 1980), Australian bush fires increased by 60% (from 2017 levels), and a Polar bear sighting was recorded in Denmark the first time ever

2028
GREAT CLIMATE MARCH
Inspired by food and biofuel price hikes that followed drought and widespread crop failure across the USA

2037
INDONESIA GOES CIRCULAR
Indonesia is the first country to execute fully circular processing on their waste and refuse. 50% of global resources are ethically and economically sustainable, coming from mining yesterday's garbage dumps. This was a result of the Global Garbage Protocol in Bogotá. Global migration has since decreased for first time in 15 years as domestic markets thrive

2020

2023
GLOBAL CLIMATE ACTION FUND ESTABLISHED
The Climate Action Fund is established in Europe and China as global courts agree to hear its first Climate Inaction Class-Action Law Suit. The SBT coalition forms to formalise metrics for all corporations and governments

2033
BLACK MARKET SAND AT AN ALL-TIME HIGH
Global sand reserves are a fraction of total demand and black-market trading has tripled, driving the industry to re-think its processes. Leading global concrete manufacturers commitment to 100% renewable energy for all production by 2040, helping Earth reach 1.5:1 consumption rate

2041
BUILDING GUIDELINES FOLLOW SCIENCE BASED TARGETS (SBTS)
SBTs are the norm for building codes and urban design guidelines in both new and retrofit design based on the SBT materials assessment metric. The C40 Cities group has evolved into the C400

2045
VIRGIN PLASTIC BANNED GLOBALLY
Circular processing of waste is now the global norm and all plastic is made from 100% reused materials

2049
COMMONS WELCOMES NEW MEMBER
The Savannah flag flies at the UN, and the global commons have a voice on the world stage thanks to the efforts of the Parliament of the Commons

2050

2042
FIRST NORTHERN WHITE RHINO IS REWILDED
BBC news reports that near extinct species of both flora and fauna have been recovering (white rhinos in Africa), as scientists report that global biodiversity loss has stabilised. This is one success story from the UN Parliament of the Commons, the catalyst for land-use preservation practices

2047
PLASTIC PATCH MUSEUM OPENS
The Plastic Patch Museum opens in Calcutta where the artefacts of the Anthropocene are displayed for posterity

2050
EARTH OVERSHOOT DAY AVOIDED
Earth reaches 1:1 consumption rate resulting from the various measures put in place, from the birth-rate decreasing for the 15th year straight, to every baby born receiving a personal carbon quota and assigned an accounting device

Jakarta, 2050

Mist rises from the marshes, almost completely obscuring the rising arcologies – the densely populated, ecologically low-impact human habitats – that lie beyond.
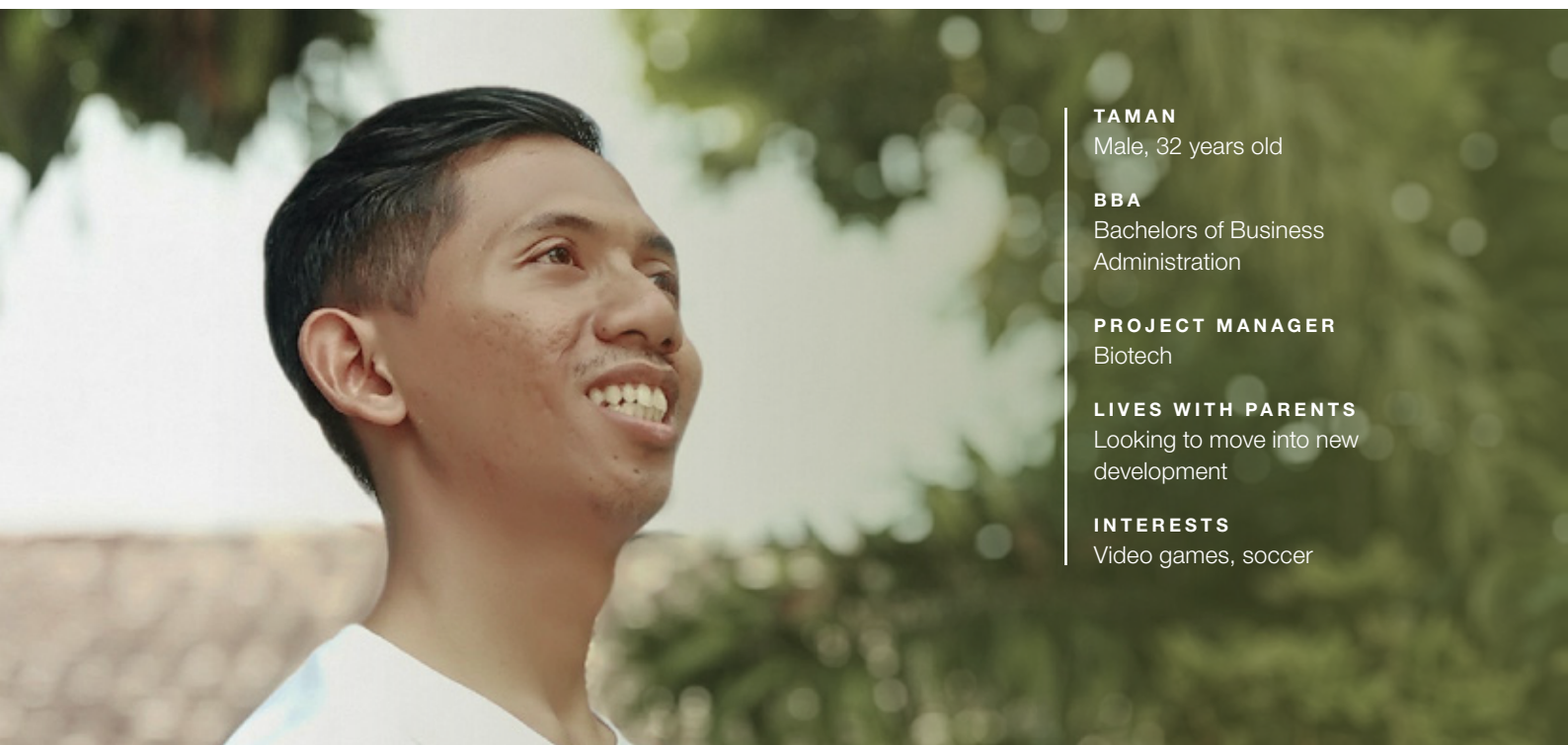
TAMAN
Male, 32 years old

BBA
Bachelors of Business Administration

PROJECT MANAGER
Biotech

LIVES WITH PARENTS
Looking to move into new development

INTERESTS
Video games, soccer

It's warm this morning, and Taman is enjoying the faint breeze as he rides through the still air, the icy, prickling sensation as it evaporates sweat from his arms and his forehead. He smiles and leans into it, pedalling harder. His earpiece chimes softly, whispers of encouragement celebrate the calories he's burnt and the carbon saved.

The surface of the marshes is flecked with green algae and blue translucent flowers. The robotic flickering of the dragonflies hovering above the water is the only apparent movement as the landscape blurs past, but Taman knows what stirs under the surface. A trillion lacelike tendrils, engineered from jellyfish DNA, are filtering and cleaning the water, stripping it of toxins and plastic molecules, separating precious organic compounds and nutrients from the centuries of human and animal waste.

Taman has seen it all, sat through all the corporate presentations and marketing meetings. He's even experienced the VR simulations where he's been shrunk down to the size of a plastic molecule and dropped into the marshes.

He's heading to a strategy meeting about the technologies right now; in fact, his boss wants him to report back on how well the European sales team's attempts to trial the same tech in Amsterdam is going. Some problem with the relatively low acidity of the silt in the canals, apparently. The whole push into Northern Europe has been a slog; mainly because getting the artificial ecosystem to adapt to the colder temperatures has been an endless headache. The product was designed to work in a much warmer climate, the one Europe was predicted to experience, but didn't. Temperatures across

Europe have returned to their historical averages. This product was not designed to operate in such a stable climate. Taman thinks about Berlin, whose temperature has been below 24°C for all of August.

His dad was angry with him for nearly a whole year when he first took this job. Maybe angry isn't the right word; disappointed. Taman's employers used to be one of The Bad Guys, one of the huge oil multinationals that spent nearly two centuries carelessly exploiting the geological past at the expense of the planet's future. At least until people made it clear they'd had enough, and their customers and shareholders rebelled against them, forcing them to change their ways, to break up, to rename and rebrand. Now, as he endlessly told his dad, they were trying to make amends, finding innovative ways to make energy and to clean up the messes they had made – they were even one of the original partners in the SBT Coalition Network. He tried to show him the corporate presentations and VR simulations, and with time he began to listen, if reluctantly. There was a bitterness the older generations still had, a suspicion that the companies were still only in it for the profits, and that somehow, they had been free of responsibility of the disasters they had caused, simply because they hadn't been as bad as everyone had expected.

Taman weaves the bike through electric traffic, takes a left at the intersection, the temperature dropping as the sun disappears behind the vast bulk of a half built arcology. Cranes rise out of its cracked eggshell shape, the apartments and office spaces already partly occupied, and emerald green vertical farms sucking up and filtering nutrients from the marshes. Jakarta is changing, rebuilding again. Nearly 23 years since they moved the capital out of the city, and a large portion of the population with it, people are starting to move back in. Taman is too young to remember it well but was told

that it used to be chronically overcrowded, permanently gridlocked, and sinking in to the swamps. They never thought the city would survive the exodus post-capital, but the reality was the city got space to breathe again. They banned cars and let the marshes reclaim the crumbling roads and some buildings, creating a city of air and space, one that let nature in. Two decades later balance had arrived, and it was time to build again, this time with care and responsibility.

A voice, deep and cheerful, shouts Taman's name through his earpiece. He glances to his left to see a cartoon of Thembi, the first re-wilded white rhino, trying to tempt him away from work with a bowl of steaming noodles and a frosted glass of tea. The Balance Day Meal Combo Special. He's in the commercial district now, the final stretch of his ride, and everything is covered with screens. News, sport, advertising, animated corporate logos, and in amongst them all, repeated over and over again, is the UN Parliament of The Commons flag. Balance Day was almost a month ago, but still the brands are riding the celebration, still using the global high of hitting the planet's neutral consumption goals to sell snacks and trinkets. Taman smiles, shakes his head – he knows his dad wouldn't approve, never trusting the corporations, fretting about his privacy and what they might be doing with all his data – but it doesn't worry him so much. Things seem pretty good. Sure, the city watches him everywhere he goes, tracks every calorie and joule he burns, but it seems like a fair trade for keeping everything balanced. Plus, he doesn't have time to worry about his data right now, he's more concerned by what mood his boss is in. He's running late, and his earpiece is whispering cooler temperatures in Amsterdam. He leans into the breeze and pedals harder.

Key indicators

This page describes how the 17 UN SDGs would fare in this scenario. The scale indicates the level to which each UN SDG has been achieved, compared to 2019. The dark coloured circle is the mean level of achievement while the lighter coloured horizontal range indicates the variance.

1

NO POVERTY
Poverty is at an all-time low.

2

ZERO HUNGER
Advances in GMO, organic, and precision agriculture feed the world.

3

GOOD HEALTH AND WELL-BEING
Predictive and precision medicine is affordable and inclusive. The global life expectancy is 79 years.

4

QUALITY EDUCATION
Education levels are increasing globally. 91% of adult's complete secondary education and 30% pursue tertiary. Life-long learning accounts are commonplace.

5

GENDER EQUALITY
Economic development and education have decreased fertility rates globally. 55% of governments report equal gender representation.

6

CLEAN WATER SANITATION
Watershed restoration has improved annual flows and water security.

7

AFFORDABLE AND CLEAN ENERGY
Renewable energy is affordable, small-scale and decentralised. Smart technology shifts control from the utility to the consumer.

8

DECENT WORK AND ECONOMIC GROWTH
A living wage is achievable in most countries. Employment is easy to sustain and levels are high.

9

INDUSTRY, INNOVATION AND INFRASTRUCTURE
Artificial intelligence is pervasive across municipal systems which are smart and flexible. Natural capital, green tech, and resilience are highly subsidised.

10

REDUCED INEQUALITY
The wealth gap is low. The most growth in GDP is seen in the middle class, which now holds the largest share. High foreign direct investment (FDI) in the Global South is focused on natural capital.

11

SUSTAINABLE CITIES AND COMMUNITIES
Urban spaces are inclusive with affordable housing and accessible green space. Green infrastructure is prioritised over grey with a focus on resilience.

12

RESPONSIBLE CONSUMPTION AND PRODUCTION
Economies are circular and value based. Natural capital is integrated into financing.

13

CLIMATE ACTION
Collaborative decarbonisation efforts have been made globally across sectors. Global mean temperature rise has remained below the 1.5oC target and the sea level has risen less than expected.

14

LIFE BELOW WATER
Marine protected areas more than doubled since 2019. 95% of the Great Pacific Garbage Patch has been cleared.

15

LIFE ON LAND
Global forest cover has increased 30% since 2019. Key carbon stores (rainforests, soils, grasslands, wetlands, etc.) are intensively restored.

16

PEACE, JUSTICE AND STRONG INSTITUTIONS
80% of governments are democratically elected. Civil liberties, such as freedom of press, religion, and expression, are at an all-time high. Data collection is high, but anonymised, open, shared, and inclusive with high accountability.

17

PARTNERSHIPS FOR THE GOAL
Global relationships are stable and international institutions successfully facilitate global protocols.
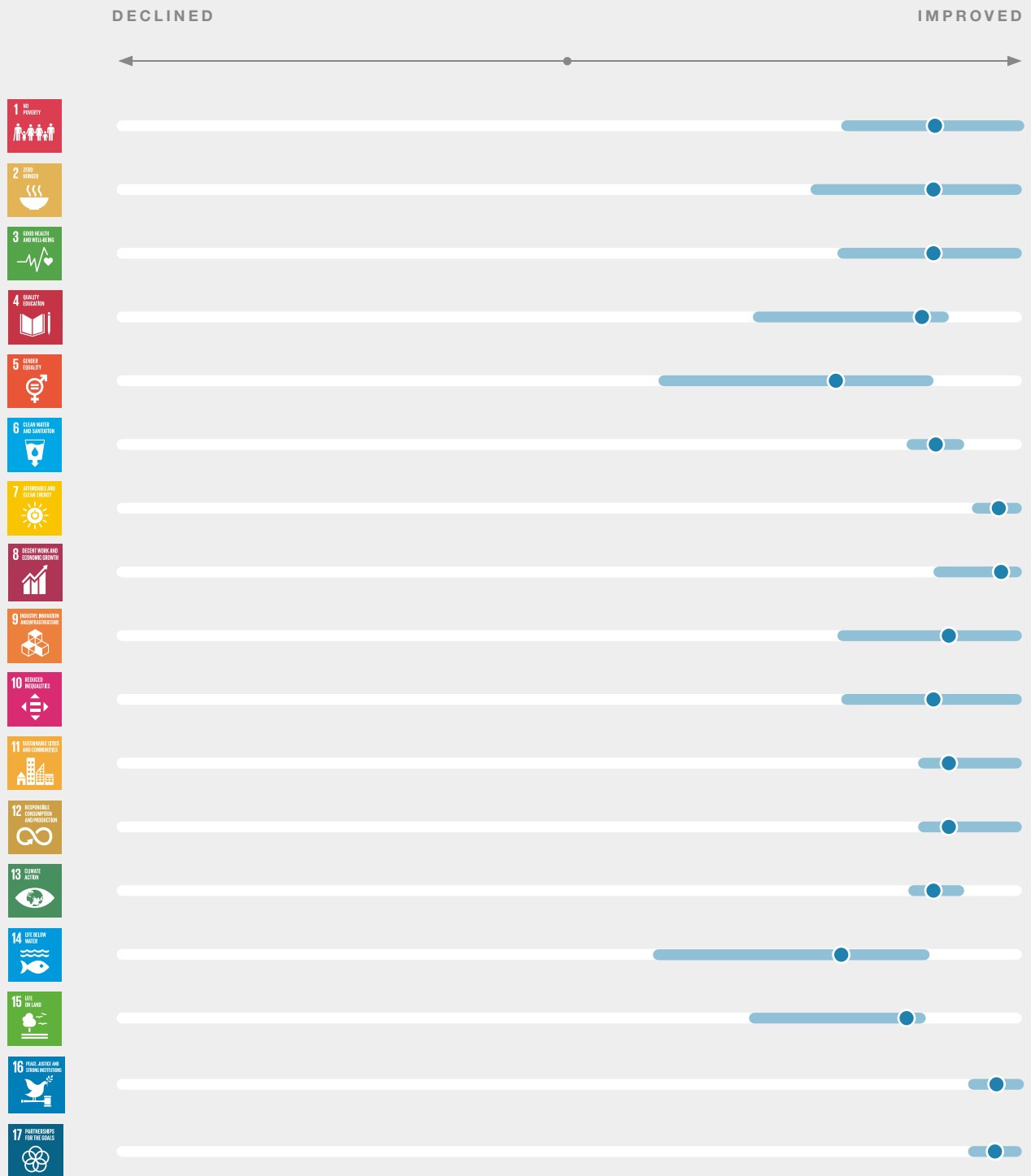
In 2050, societies are highly divided, unequal and suppressed. Most of the Earth's ecosystems are on a clearly chartered recovery plan.

Greentocracy

Climate action and biodiversity recuperation are the top-line of every national and transnational agenda. The results of the galvanised global efforts have been unprecedented for the environment, but not without significant sacrifice from people who are realising the trade-offs did not quite work out for them. Humanity now lives in self-imposed servitude to the environment under the mantra of 'happy planet, happy people.'

For most of the last two decades, the Earth and its health have enjoyed the highest priority in the public consciousness. The scale and speed of environmental degradation of the first quarter of the century, with extreme weather events, rising urban air pollution and climate migration, drove governments and major global cities to act swiftly, and strictly, on climate action. Popular unrest and ardent civil demand led to unanimous agreement that everyone must help the planet to heal. Protected lands have expanded worldwide, and significant resources have been allocated to restoring ecosystems. The extinction curve is flat and many species previously on the brink of extinction are regenerating. The effects of climate change can still be felt and sea levels continue to rise, yet the impacts are less severe than expected.

Environmental prioritisation was an achievement of the Science Based Targets initiative and the ecological global framework adopted at COP32, the United Nations' Climate Change conference. These targets were quickly integrated into all aspects of legislative decision making across the world. Many countries, including the three largest global economies (China, India, USA), appointed powerful scientific advisory boards that directly influence national legislation. Other economies followed their lead and adopted strict regulation and large-scale punitive measures for those that continued business-as-usual operations. Whilst some OPEC countries were able to successfully transition from oil-based to more diversified economies, others struggled to recover from the economic implications of their stranded fossil fuels assets.

Achievement of the targets came at a much greater expense to society than expected. The changes to where people lived, what they ate and how they travelled were sudden and extreme. They permeated every aspect of daily life. A myriad of new job types was created, but most were dangerous and undesirable, as workers were tasked with cleaning up environmental pollutants and processing materials for re-use. Extreme urban densification, driven by urban growth boundaries for land-use regeneration, led to a premium on space. As a result, many low-income individuals are living in small, yet sustainable, apartments - an average of 8m^2 per person. Pervasive carbon taxation and individual carbon allowances have severely slowed consumerism for the aspiring global middle-class. To save on their carbon allowance, people regularly repurpose used items and upcycling is at an all-time high, with a thriving 'Do Everything Yourself (DEY)' culture. In many countries, rubbish collection and prospecting are a reliable income stream.

Diets are barely recognisable from what they were 30 years ago. The prices for carbon-intensive foods, such as coffee and meat, have increased 500% compared to 2020 levels, with strict allowances in place for every citizen. Changing weather patterns caused bees and other insects to migrate north to warmer temperatures, which destabilised ecosystem dynamics. Agriculture in the previously most arable countries was devastated, whilst predictions of overfishing became a reality as the global fish stock was exhausted.

Extreme urban densification, driven by urban growth boundaries for land-use regeneration, led to a premium on space.

Seventy per cent of 'meat-like' protein is grown in labs and crated from plant-based products and the cultivation of animal cells..

The absence of cheap and abundant protein sources, and the need to leave land for nature, created the chasm into which Surrogate Pseudo-Proteins (SPPs) exploded. Seventy per cent of 'meat-like' protein is 3D-printed in labs, created from plant-based products and the cultivation of animal cells. Distributed globally under the tradename LABFood, the rapid development of SPPs was heralded a success for transnational co-lab-oration, with European scientists, Chinese infrastructure, and USA crops delivering these soy-based food substitutes. The use of SPPs expanded globally, with LABFood quickly becoming one of the world's most profitable companies and their CEO awarded the Nobel Prize for helping minimise global hunger.

With nearly 60% of the global population relying on synthetic food sources, the first signs of detrimental health impacts are starting to show. Fears are compounded following a disturbing article in the leading academic journal, Nature in 2040, citing severe micronutrient deficiencies across large parts of the population due to over-reliance on synthetic food sources. It also questioned the influence of hyper-densification, limited living space, and restricted access to nature.

Driven by extreme ecological regulation, societies are now highly divided, regulated and unequal, with most citizens increasingly disillusioned; they are mere pawns in the Greentocracy. Since the first civil protests in 2040, the SunGrown movement has grown significantly, demanding access to the natural, non-LABFood enjoyed by the affluent part of the global population, as well as more access to nature for leisure activities. However, the requirement to expand farmland and roadways to achieve these demands would go against the principles of land-use regeneration and has therefore been vetoed by regulators.

As a way of limiting environmental impact, governments continue to discuss the controversial topic of global population control. Some legislation has already been tested, but ethical concerns prevent large-scale implementation. The results turned out to be inconsequential, as the poor state of society is already enough to prevent people from wanting to bring children into the world.

9.5bn
global population

high wealth gap

1.5°C
increase

medium global
cooperation

stable weather

97%
clean energy

Timeline

2024
MANDATORY ECOLOGY AND GREEN TECH EDUCATION
STEM education, especially ecology and green tech education, became mandatory curricula in most countries, driven by scientific advisory boards assisting government decision making

2027
'PLANET FIRST' GUIDES GLOBAL DECISION MAKING
CoCA (Cities of Climate Action) agree on planet first as a guiding principle above all else at their annual meeting at the Virtual Planet Meeting room — no physical travel was necessary. In line with global agreements and regulation, the most powerful cities across the globe are driving massive change

2032
FIRST ECO-RE-EDUCATION
C40 cities open pilot "Eco-Re-education" facilities for citizens who repeatedly violate environmental codes of behaviour

2020

2026
COP32 RATIFIES SBT FRAMEWORK
Global acknowledgement of overfishing and the ratification of science-based targets as an accepted global framework are agreed at COP32 in Singapore

2028
CARBON QUOTA TRIALS
Facilities opened in Copenhagen and Los Angeles to introduce personal carbon quotas to their populations, intend to become mainstream by 2035

2033
SYNTHETIC FOOD PRODUCT TAX BREAKS
Considerable tax breaks for synthetic food products: as edible fish stocks, the world's most important protein source, are nearing depletion and biodiversity is at an all-time low, governments recognise synthetic food products as the only option to feed their populations

2042
EXPANSION OF MARINE PROTECTED AREAS
UN expands Marine Protected Areas (MPAs) across the globe and cruise-liners are banned in the North-Sea, Baltic-Sea, North-Atlantic by UNEP backed Northern Nature Alliance

2046
GLOBAL CARBON XCHANGE OPENS
Global Carbon Xchange (GCX) opens in Lagos, a city that became a leader in the CoCA initiative following the successful agreement of 2027

2050

2040
NUTRIENT DEFICIENCIES FROM LABFOODS
Nature journal article rebuking LABFoods Surrogate Pseudo-Proteins claims that a significant share of the global population may be suffering from severe micronutrient deficiency or 'hidden hunger' Followers of Nature and members of the burgeoning 'SunGrown' movement demand investigation of the issue; knowledge of previous nutrient deficiencies cases has been suppressed

2049
GHG TARGETS ACHIEVED
Global carbon levels have declined to 1950 levels

2050
SECOND GLOBAL MARCH FOR THE PEOPLE
The second global march 'people first – not planet' takes place in most CoCA cities across the globe

Diamniadio Lake City, 2050

The bus is crammed, standing room only. Too many people and not enough seats. So many bodies that Moussa can't make out their forms, just visual snippets and clues:

MOUSSA
Male, 46 years old

RAISED IN RURAL SENEGAL

HIGH SCHOOL DIPLOMA
Additional vocational office training. Certificate earned in refugee camp

GOVERNMENT OFFICE WORKER
Civil Servant

MARRIED
With a toddler

INTERESTS
Crafting, making/repairing clothes

an elbow wrapped in a designer upcycled shirt, a hand holding the scratched case of a refurbished tablet, a face hidden behind second-hand sunglasses. It rained this morning, the usual warm drizzle, and as it evaporates off water-resistant clothing it hangs in the air around Moussa's face like a tropical mist.

He's got a seat at least, crammed up against the fogged-up window. It's some small consolation for the bus being stationary for what feels like an hour. He knows it hasn't been that long, probably mere minutes, but he refuses to check the time, to see how late for work he's really going to be. Instead he turns to the window, wiping a viewport through the condensation with a gloved hand, trying not to think about what bacteria has been deposited by the communal fog.

Outside the bus Diamniadio Lake City is rain slicked, the little they can see of it. There are too many bodies, as though they've spilled out from the bus and filled the streets, blocking traffic and filling the sidewalks and bike lanes. It somehow feels more claustrophobic out there than here, Moussa thinks, pleased he didn't jump off the bus at the last stop to try and walk the rest of the way. He very nearly did, but he'd have been at the office no sooner, lost instead in the sea of people. Plus, the protests make him anxious now. He'd enjoyed them as a teenager, relishing that feeling of solidarity and group power, knowing that he was actually making a difference, forcing the government to sit up and take notice. He'd shut down traffic just like this – shut down the whole city for days – the simple tactic of filling the streets with bodies whose presence the autonomous cars and buses were programmed to never ignore.

But this is different, and it saddens him. Moussa can tell from reading the placards, from the muffled chants that filter in through the bus's windows. People First. Give Us Back The Countryside. Human Lives Matter. We Want Real Food. We Want The Right To Choose.

It's a confused message, but he has some sympathy. He's never been able to afford a car, let alone keep one charged. He hasn't been on a plane since he was eight years old, not left the country for at least twenty years. It's been nearly a year since he got out of the city even, since he took one of those government tours out into the countryside, saw forests and farms, the protected spaces and nature reserves. So lush, so green, so beautiful. His water and electricity bills are as high as everyone else's, his Carbon Allowance just as tight as the protesters.

But he can't help thinking the protesters are being selfish. The same selfishness that got them here in the first place, the same focus on individuality, the same centuries-long abdication of communal responsibility that he marched against when he was a teenager. And he can't stop thinking about the storms when he was even younger, or about his mother, waist high in grey water, sobbing in the kitchen of their now abandoned home. He remembers his father holding him close in a supermarket, protecting him from the angry crowds pushing past each other to get to meagrely stocked shelves.
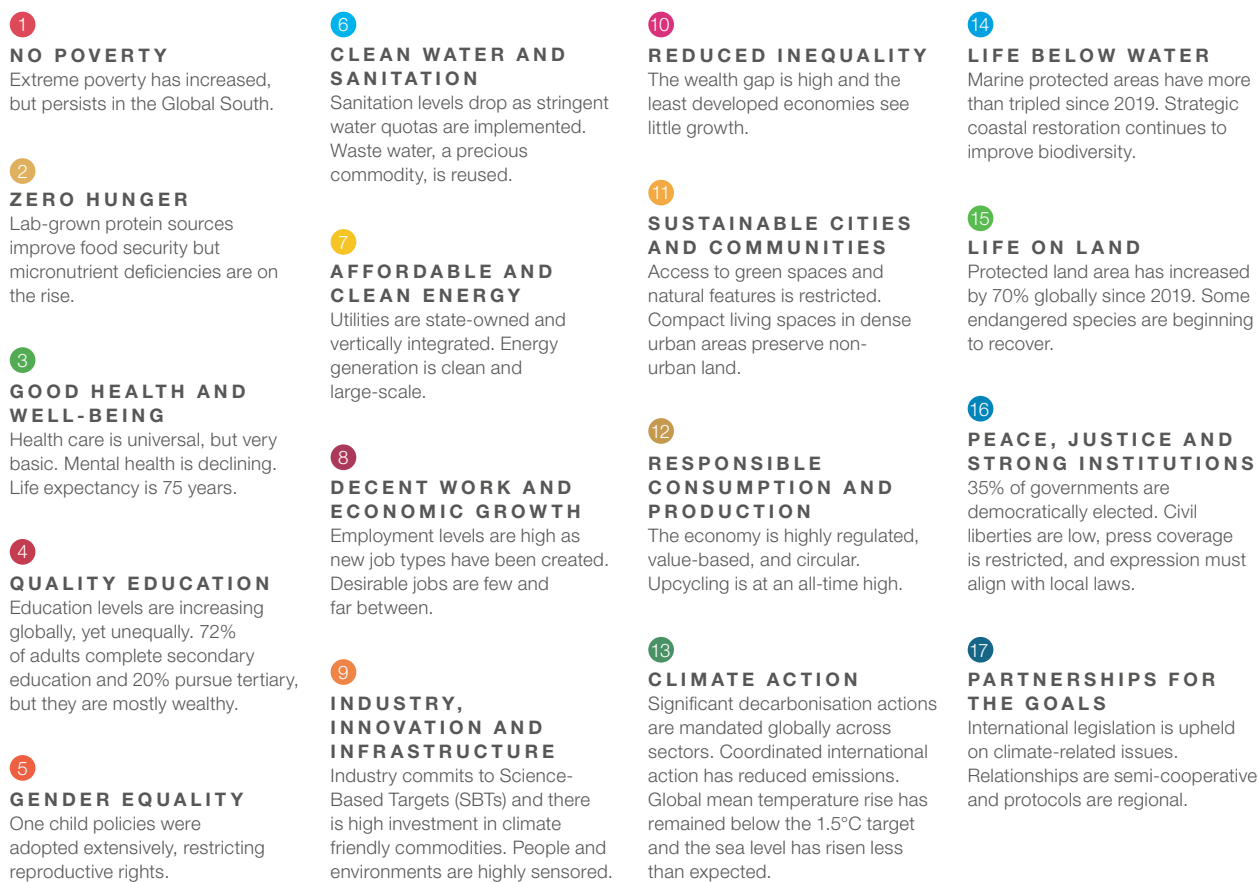
He remembers all this as he looks out on the sea of marchers, all splendid in their iconic high-viz vests, and wonders when everyone's memories got so short. He wonders when everyone stopped believing that the everyday sacrifices they make are worth it – that they work – that they're the only way to stop the oceans from rising, to let the countryside heal itself, to let the fish stocks start slowly recovering.
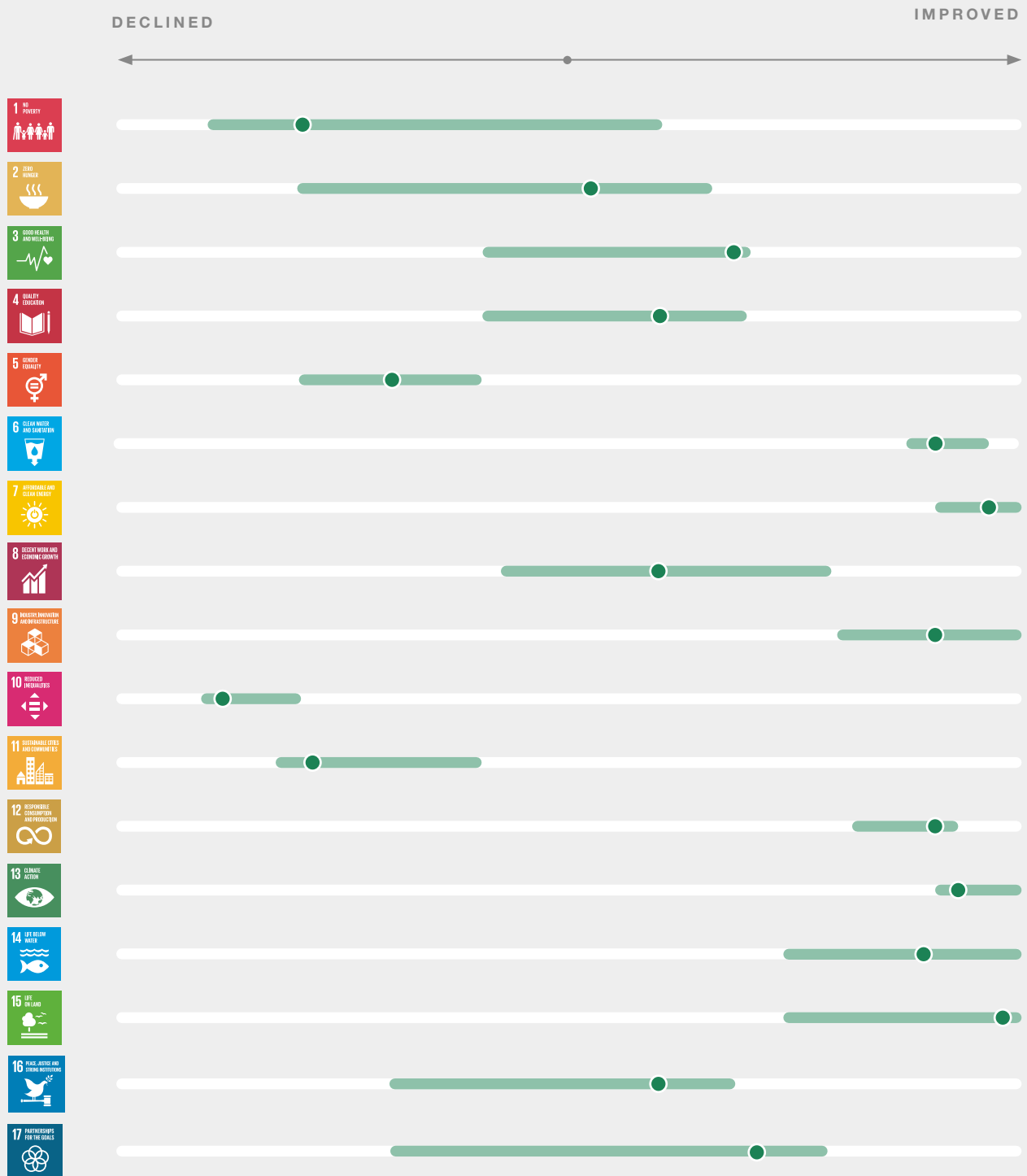
He's jarred from thoughts by shouting, angry and pained, and for a second, he thinks the protesters have broken in, have boarded the bus. But then he feels the mass of passengers on the bus shift in shape, as though recoiling, trying to create a bubble in itself, and realises where the shouting is coming from. Some commuter close to breaking point, some poor, confused and anguished soul that can't take it anymore. Societal Stress Disorder, they call it on the news. There's a lot of it around. Some people just can't take the crowds anymore, the cities too full since the countryside and the exurbs were evacuated except for robots and essential workers. And then there's the reports and rumours that their diets aren't helping, that the lab grown meats and printed proteins don't have the right nutrients, and that it's affecting people's brains, their emotional states.

Moussa stares down into the congealing, artificially flavoured Starbucks Roach Milk Latte that's going cold in his hands and the LABFood breakfast that has been in the news lately; he feels his stomach flip. Best not to think about that stuff too much. Instead he thumbs on his earbuds, letting noise cancelling frequencies drown out the poor man's cries, lets ambient soundscapes take their place. Bird songs, waves crashing on beaches, the rustle of wind through leaves. Sounds he only hears now from his mobile apps. His phone buzzes angrily to warn him how expensive using the earbuds are, how much of his Carbon Allowance they'll use up. He dismisses it with a swipe and closes his eyes. Everybody needs an escape sometimes. He'll make the sacrifice somewhere else.
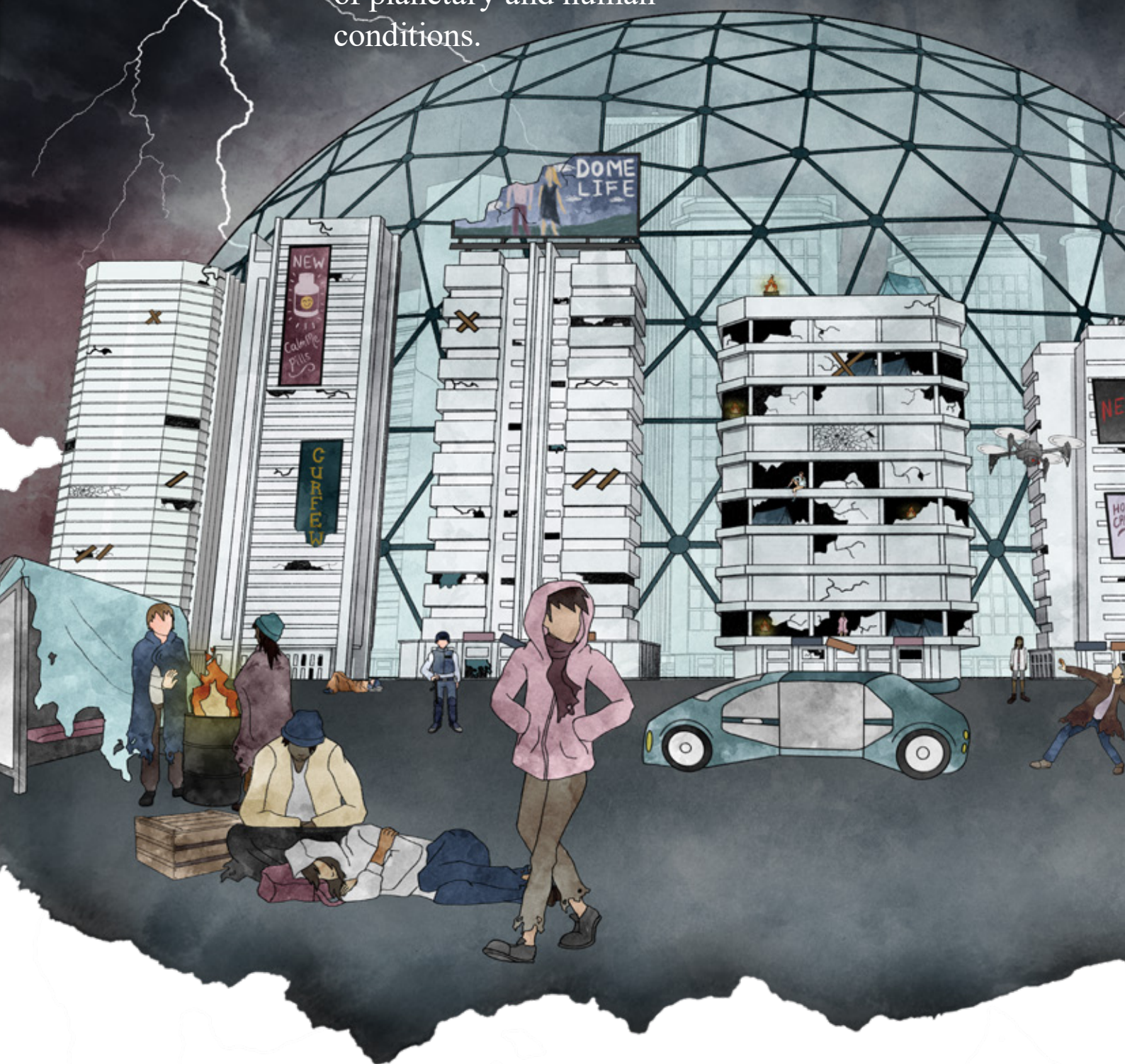
Key indicators

This page describes how the 17 UN SDGs would fare in this scenario. The scale indicates the level to which each UN SDG has been achieved, compared to 2019. The dark coloured circle is the mean level of achievement while the lighter coloured horizontal range indicates the variance.

1

NO POVERTY
Extreme poverty has increased, but persists in the Global South.

2

ZERO HUNGER
Lab-grown protein sources improve food security but micronutrient deficiencies are on the rise.

3

GOOD HEALTH AND WELL-BEING
Health care is universal, but very basic. Mental health is declining. Life expectancy is 75 years.

4

QUALITY EDUCATION
Education levels are increasing globally, yet unequally. 72% of adults complete secondary education and 20% pursue tertiary, but they are mostly wealthy.

5

GENDER EQUALITY
One child policies were adopted extensively, restricting reproductive rights.

6

CLEAN WATER AND SANITATION
Sanitation levels drop as stringent water quotas are implemented. Waste water, a precious commodity, is reused.

7

AFFORDABLE AND CLEAN ENERGY
Utilities are state-owned and vertically integrated. Energy generation is clean and large-scale.

8

DECENT WORK AND ECONOMIC GROWTH
Employment levels are high as new job types have been created. Desirable jobs are few and far between.

9

INDUSTRY, INNOVATION AND INFRASTRUCTURE
Industry commits to Science-Based Targets (SBTs) and there is high investment in climate friendly commodities. People and environments are highly sensored.

10

REDUCED INEQUALITY
The wealth gap is high and the least developed economies see little growth.

11

SUSTAINABLE CITIES AND COMMUNITIES
Access to green spaces and natural features is restricted. Compact living spaces in dense urban areas preserve non-urban land.

12

RESPONSIBLE CONSUMPTION AND PRODUCTION
The economy is highly regulated, value-based, and circular. Upcycling is at an all-time high.

13

CLIMATE ACTION
Significant decarbonisation actions are mandated globally across sectors. Coordinated international action has reduced emissions. Global mean temperature rise has remained below the 1.5°C target and the sea level has risen less than expected.

14

LIFE BELOW WATER
Marine protected areas have more than tripled since 2019. Strategic coastal restoration continues to improve biodiversity.

15

LIFE ON LAND
Protected land area has increased by 70% globally since 2019. Some endangered species are beginning to recover.

16

PEACE, JUSTICE AND STRONG INSTITUTIONS
35% of governments are democratically elected. Civil liberties are low, press coverage is restricted, and expression must align with local laws.

17

PARTNERSHIPS FOR THE GOALS
International legislation is upheld on climate-related issues. Relationships are semi-cooperative and protocols are regional.

The mid-21ˢᵗ century is marked by the extensive degradation of planetary and human conditions.

Extinction Express

Climate change and the inexorable consumption of Earth's resources has resulted in fundamental destabilisation of natural systems. Resource, energy, water and food shortages are pervasive across the world. Environmental consciousness is largely non-existent.

The established world order has shifted, and the global centre of power has moved to the East. China has a strong economic presence and position globally and dominates the research and manufacturing of technologies. To meet the global population's growing demands, resource colonies on the moon and in the deep sea have been established.

The Amazon rainforest, one of the world's largest carbon sinks, is almost entirely cleared. The Brazilian government sold large portions of the forest to online retailers in the 2030s to provide resources for their ever-increasing shipping needs; packaging is in high demand. Space and deep-sea mining are booming as demand for natural resources have surpassed the previous all-time high. The incentive to reach and operate in these inaccessible and inhospitable locations is greater than ever; access means the ability to harvest rare materials and resources that are increasingly scarce on Earth. While the USA, China, Russia and Europe conduct the vast majority of extractions, Japan, India, Indonesia, Iran, Brazil and others are expanding their presence, leading to an increase in resource conflicts.

Natural resources that were previously taken for granted and considered basic human rights – such as water, air, ozone, land and the oceans – are now genuine commodities. Water sources are highly regulated with restricted access; corporations now hold a monopoly over the majority of the global water supply. Those who can't afford to pay for the premium cost of water must rely on localised, often contaminated water sources. Similarly, clean air is accessible only to those who can afford it. Large-scale air domes have been erected over many of the world's most prominent cities, including Shanghai, Delhi and London, to create safe havens for some segments of their populations. Individuals restricted from accessing air domes experience increased rates of asthma and lung cancer that go largely untreated.

Agricultural systems suffer extensively from the transformed climate and regularity of extreme weather. Geo-engineering and GMO crop development are the only way to feed the global population. Seeds are controlled by Holycrop, an American-based business, which monopolises the market. Crop strains are continuously being updated and improved to withstand the ever-more serious climate shocks and new threats from insects and microbes. To maintain productivity, farm land is regularly treated with the newest artificial nutrients and fertilisers, leading to continued and severe soil degradation. Agricultural producers must subscribe to expensive and ever-changing upgrade plans with restrictive user agreements limiting where they can sell, who they can sell to, and what types of fertilisers they can use. Consequently, many small farmers have been pushed out of the industry and agricultural activities are almost exclusively completed at an industrial level.

Geo-engineering and GMO crop development are the only way to feed the global population.

Large-scale air domes have been extracted over in many of the world's most prominent cities, to create safe havens for some of the populations.

The farmers continue to struggle, with their livelihoods controlled by the corporations.

Most nations have adopted a nationalist agenda. The only look outwards to engage in bi-lateral agreements for the exchange of natural resources or food. Mass climate migration and resource wars are daily occurrences. Governments are widely criticised by their constituents, accused of wilfully shirking their responsibilities towards ecosystem health. Small guerrilla communities are common in localised areas, attempting to undermine the dominating empires. Governments seek these groups out and contaminate land and waterways in surrounding areas to cut off all access to resources.

Isolationism has been on the rise for years, and society is driven by a fear of the 'foreign' and 'different'. This has been exacerbated by an unheralded number of climate refugees. Europe was the first region to implement an immigration cap and put in place asylum bans and is the driving force behind 'solving' the migration crisis through the modernisation of refugee camps – city sized camps on remote islands and in desert areas to house the world's poorest, far away from the rest of society. Those who live in these camps refer to them as 'controlled hells'.

There is a stark division between the have-lots and the have-nots. Goods are easily accessible, but only to the wealthy few. The global middle class is almost non-existent. Information and knowledge exchange across borders is shaped by protectionism, and five independent internets have developed. The ubiquity

of social scoring systems has resulted in a new type of caste system, in which few people can choose their jobs freely. Previously high income, high status tech work is widely automated, and the world has seen a resurgence in low-paying service jobs, with the lower classes, the majority, scrambling for any work. Food and resource processing take place in industrial factories where workers have little protection and few rights. These roles, where humans work alongside robots, keep a large portion of the human population busy.

These changing human conditions have resulted in rampant use of 'smart' and 'happy' drugs that manipulate the human brain, helping to cope with daily life. Reliance on these drugs has led to an increase in perceived health while new types of resistant bacteria continuously threaten large portions of the population. Very few people can rely on, let alone afford, access to healthcare, but those that can use precision medicine and genome editing, further dividing society along the lines of basic human needs.

9.8bn
global population

high wealth gap

2.5°C
increase

low global
cooperation

extreme weather

23%
clean energy

Timeline

2022
SMOG DOMES FOR THE WEALTHY
The smog crisis in the largest Asian cities has become unbearable, leading to large-scale smog dome projects for commercial and wealthy residential areas

2030
ILLEGAL ARCTIC SEA MINING
The race for the Arctic seabed accelerates as the Arctic is free of ice in summer and it is now easier to extract materials from the seabed; illegal mining is at an all-time high, and countries do not even try to hide their endeavours; no country's filed claims to extended continental shelfs have been validated by the United Nations Convention on the Law of the Sea (UNCLOS)

2031
INCREASING NUMBER OF CLIMATE MIGRANTS
Large-scale coastal flooding and the collapse of coastal biodiversity results in an unprecedented wave of climate migration. The EU introduces a stringent refugee immigration limit

2020

2024
"NEW FOOD" PATENTS SOAR
Huge investments in GMO research and explosions of patents for "New Food" — Holycrop makes progress towards total control of the global seed stock

2026
CHINA TACKLES FOOD CONSTRAINTS
Adoption of China's Fifteenth Five-Year-Plan (2026-2030) under the headline of "agricultural expansion for the people" and "green revolution." Due to its population explosion in recent years, China struggles to find space, food, energy and resources to sustain its population

2033
CHINA-RUSSIA ARCTIC ALLIANCE (CRAA)
China supports Russia through technology exchange in its Arctic seabed mining efforts – they recognised the mutual benefits (China: access to territory they were not able to claim; Russia: access to technology to effectively mine the ocean)

2039
BAN ON FOREIGN STUDENTS
Australia and New Zealand ban all foreign students from entering their countries. Isolationism and "fear of the foreign" is at an all-time high

2040
MOON AND DEEP-SEA MINING BY CORPORATES
In an order less world, the first come, first served principle prevails: the highest corporate and state spenders effectively control the extraction of resources (water, rare elements, and rare minerals) from the moon and many deep-sea territories

2050

2038
ANOTHER "SAFE HELL" OPENED
"Safe hells" have been created across the globe to house climate refugees, many on floating islands and in deserts to keep "them" far away from the rest of the population

2045
ONE MILLIONTH DESIGNER BABY BORN
The one millionth designer baby is registered; it is now common for the world's top 1% to fly in to China's premier fertility clinic, BabyX, to select their future baby's attributes

2049
NEW ZIKA OUTBREAK
Toronto experiences its first Zika epidemic

Oslo, 2050

The car guides itself silently through sparse traffic, Caitlyn gazes out through the tinted windows at the passing towers, her eyes following their elegant steel and window lines skyward where they merge and intersect with the geodesic mesh of the dome.
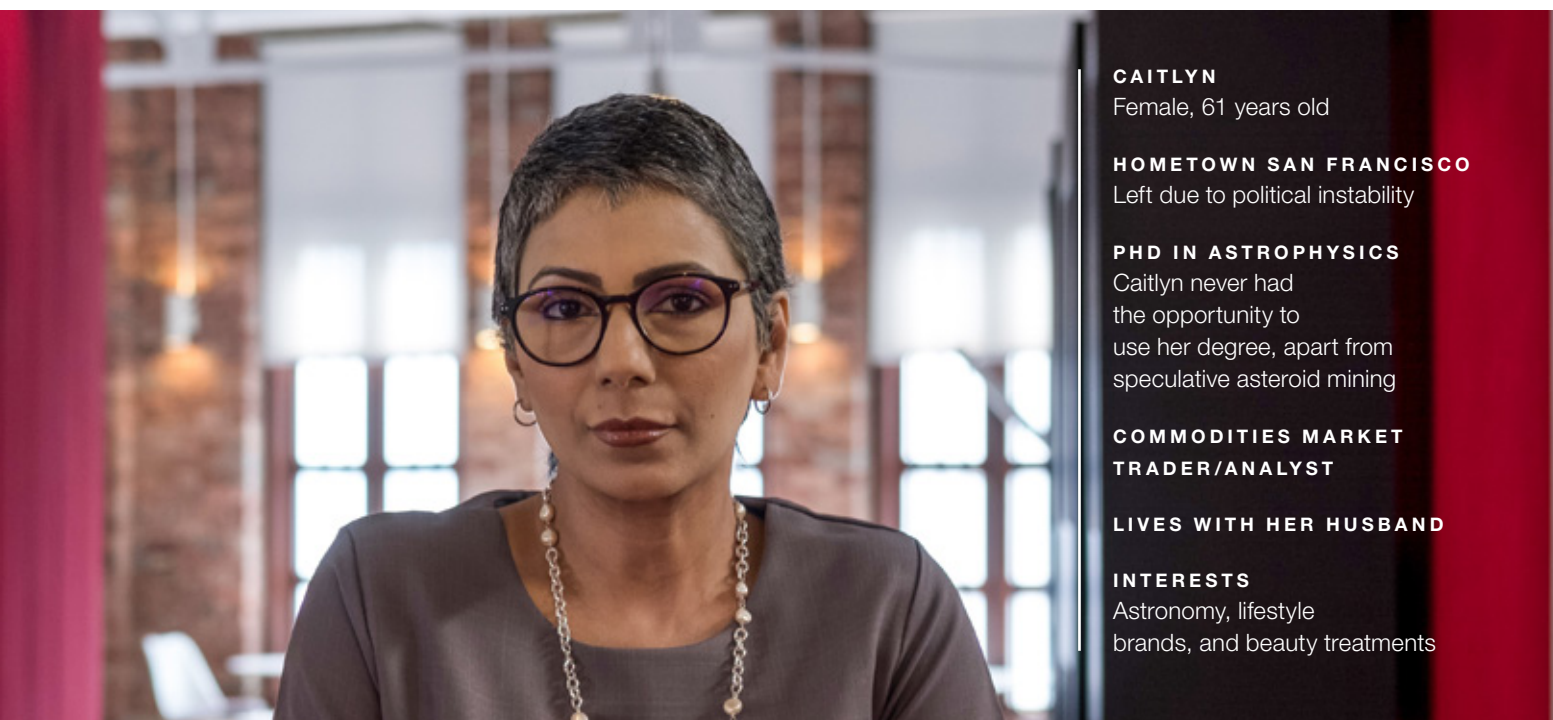
CAITLYN
Female, 61 years old

HOMETOWN SAN FRANCISCO
Left due to political instability

PHD IN ASTROPHYSICS
Caitlyn never had
the opportunity to
use her degree, apart from
speculative asteroid mining

**COMMODITIES MARKET
TRADER/ANALYST**

LIVES WITH HER HUSBAND

INTERESTS
Astronomy, lifestyle
brands, and beauty treatments

Filtered daylight falls gently through the hexagonal panes, birds flying above making lazy silhouettes as they circle with almost algorithmic precision. It's the first time she's left her building in about a week, she realises, vowing to do it more often. Something about it is intoxicating, but she can't decide what. Maybe it's the streets, how clean and beautifully lit they seem, like a perfect film set, or maybe it's the gentle ballet of the automated traffic, and the precise, minimalist sense of order and restrained control. Or maybe it's just that microdose of Contentment she inhaled alongside her espresso this morning to help her get through the day.

She laughs gently to herself, shakes her head, and checks her reflection. The wrinkles on her forehead are slowly starting to flatten out – a result of the DNA shifting retrovirus the clinic in Malmo injected into her face, even now slowly regenerating her skin and wiping away the creases. It was expensive, but the results are worth it. She's worth it.

She turns her attention back to the tablet unfurled in her lap. Its screen is full of monochrome images of crater fields and orbital paths, infographics of projected mineral density and the calculated impact on global rare earth commodity prices. She smiles to herself. If the probe's readings are right, there's enough neodymium in this one rock to destabilise the mining economies of at least two African nations. She's already got a couple in mind.

Getting into an orbit where it can be properly assessed, let alone processed, is going to be costly. She swipes the tablet to reveal her portfolio, tapping at icons to see

where she can free up some capital. Somewhere, deep in corporate dark pools in NYC and Shanghai, invisible AI agents start to stir, watching a million transactions a second to find patterns in the market.

The car's obsidian black dashboard, free of visible displays or controls, chimes gently at her, announces with restrained charm that they are passing through one of the dome's security checkpoints. She looks out the window again, just as they glide through the gateway, the city outside sliding into view. It's not that much different really, she thinks. It's brighter, sure, with no dome to block out the worst of the UV, but otherwise it's the same blue skies, the same elegant buildings, the same ballet of automated traffic. She really should get out more.

By the time she looks back down into her lap one of her agents has short sold enough stock of a Belgian orbital haulage company to anonymously seize her a controlling share. That should make shifting the asteroid's course more cost effective. Now, to see if she can find some way of finding cheaper fuel. Something hits the window next to her, hard; she screams and throws herself sideways onto the leather seat. For the first time she realises the car is stationary. The window is a cobweb of shattered lines transposed over a constant, looping, glitched burst of video-noise static, until it crumbles and gives way, falling inwards, littering the seat next to her with shards of liquid crystal.

Noise fills the previously silent car, and the world outside looks like a TV switched to a different channel. It's dark, as though the sun was suddenly extinguished. Her hands trembling, Caitlyn slowly straightens herself up to peer outside, the heat hitting her face, and the first thing she sees is a woman, screaming and dirty, arms outstretched at her in desperation, as a faceless police officer in polycarbonate armour drags her away from the car. He throws her to the pavement, garbled orders barked from behind his visor, as his partner silences her with a nightstick blow to the skull. Behind them more police, watched over by a swarm of micro-drones, rip apart the tents that line the freeway, hurling violence onto their dishevelled inhabitants.

Caitlyn struggles for breath, tries to blank out the screams and sirens. Beyond the disintegrating tent city, the dome – her home – rises, and from the outside she's surprised by how run-down it looks, how its windowless surface is smeared with grime and black dust. From out here it looks almost as desperate as the fractured city that surrounds it, like a hermetically sealed prison, and she's jolted into confronting her reality, that the blue skies she wakes up to every morning are a lie, a simulation meant to comfort and distract her. They're gone now, along with the birds that were never there, replaced only by the constantly rolling black clouds and the acrid taste of smoke. Her eyes start to sting and squinting through tears she can make out that the hills around the city are glowing deep red against the dark sky.

And then, within a few seconds, it's all over. The car plunges into darkness before softly lighting itself as protective shields spring from the doors to cover all the windows, including the shattered one. Silence returns as the sound-cancelling speakers kick back in, the air around her starts to cool as the climate adjusts itself. She can feel the car start to move.

Her hands still tremble as they search wildly in her purse, trying to find the vaporiser. She pulls it out and stabs at its touchscreen, dialling up a dose of CalmMe. She lets it charge, then takes a long drag, the thin vapour exiting her lungs and disappearing into the car's hidden air filters. She takes another drag, then a third, before she feels herself start to calm down, her breathing starting to regulate once more. A feeling of peace and contentment descends gently over her.

Her gaze falls back into her lap as she smooths creases out of the tablet, like the virus smoothing out her ageing skin. Crater fields and orbital paths, infographics of projected mineral density. She taps at the screen, focuses again, as she sends another swarm of agents out to find her a source of cheap rocket fuel.

Key indicators

This page describes how the 17 UN SDGs would fare in this scenario. The scale indicates the level to which each UN SDG has been achieved, compared to 2019. The dark coloured circle is the mean level of achievement while the lighter coloured horizontal range indicates the variance.

1

NO POVERTY
Living wage jobs are inaccessible to the majority. Major economic loss is experienced regularly due to extreme weather.

2

ZERO HUNGER
Climate change and biodiversity loss reduce crop yields. Adaptive seeds are monopolised. Fisheries are exploited to depletion.

3

GOOD HEALTH AND WELL-BEING
Air pollution is the leading cause of death (10 million a year globally). Access to healthcare is low. Life expectancy is 72 years.

4

QUALITY EDUCATION
Globally, education levels increase slightly. 68% of adults complete secondary education while 15% complete tertiary, yet this is limited to the wealthiest regions.

5

GENDER EQUALITY
Lack of access to contraception and education keeps fertility rates high in the least developed countries.

6

CLEAN WATER SANITATION
Major waterways are highly contaminated. Potable water is corporately controlled and costly.

7

AFFORDABLE AND CLEAN ENERGY
Energy prices surge driving some gains in efficiency, yet there is a continued reliance on fossil fuels. Hydropower is affected by drought and erratic weather.

8

DECENT WORK AND ECONOMIC GROWTH
Unemployment is high and job security is low. Many perform attainable yet undesirable jobs and have limited protection and rights.

9

INDUSTRY, INNOVATION AND INFRASTRUCTURE
Internet of Things and Artificial Intelligence are mainly implemented for individual and corporate gains.

10

REDUCED INEQUALITY
Global and domestic wealth gaps are high. Growth has been concentrated in major developed and emerging economies.

11

SUSTAINABLE CITIES AND COMMUNITIES
Many coastal cities face frequent and extensive flooding, displacing millions.

12

RESPONSIBLE CONSUMPTION AND PRODUCTION
Economies are consumption-based.

13

CLIMATE ACTION
The Arctic is largely free of summer ice, driving greater than predicted sea level rise. Global mean temperature has far exceeded the 2°C target.

14

LIFE BELOW WATER
90% of coral reefs experience annual bleaching events. Deep sea mining disrupts aquatic ecosystems.

15

LIFE ON LAND
Drylands expanded to 53% of global land area due to extensive deforestation, climate change and alterations in land use. Biodiversity loss is at extreme levels.
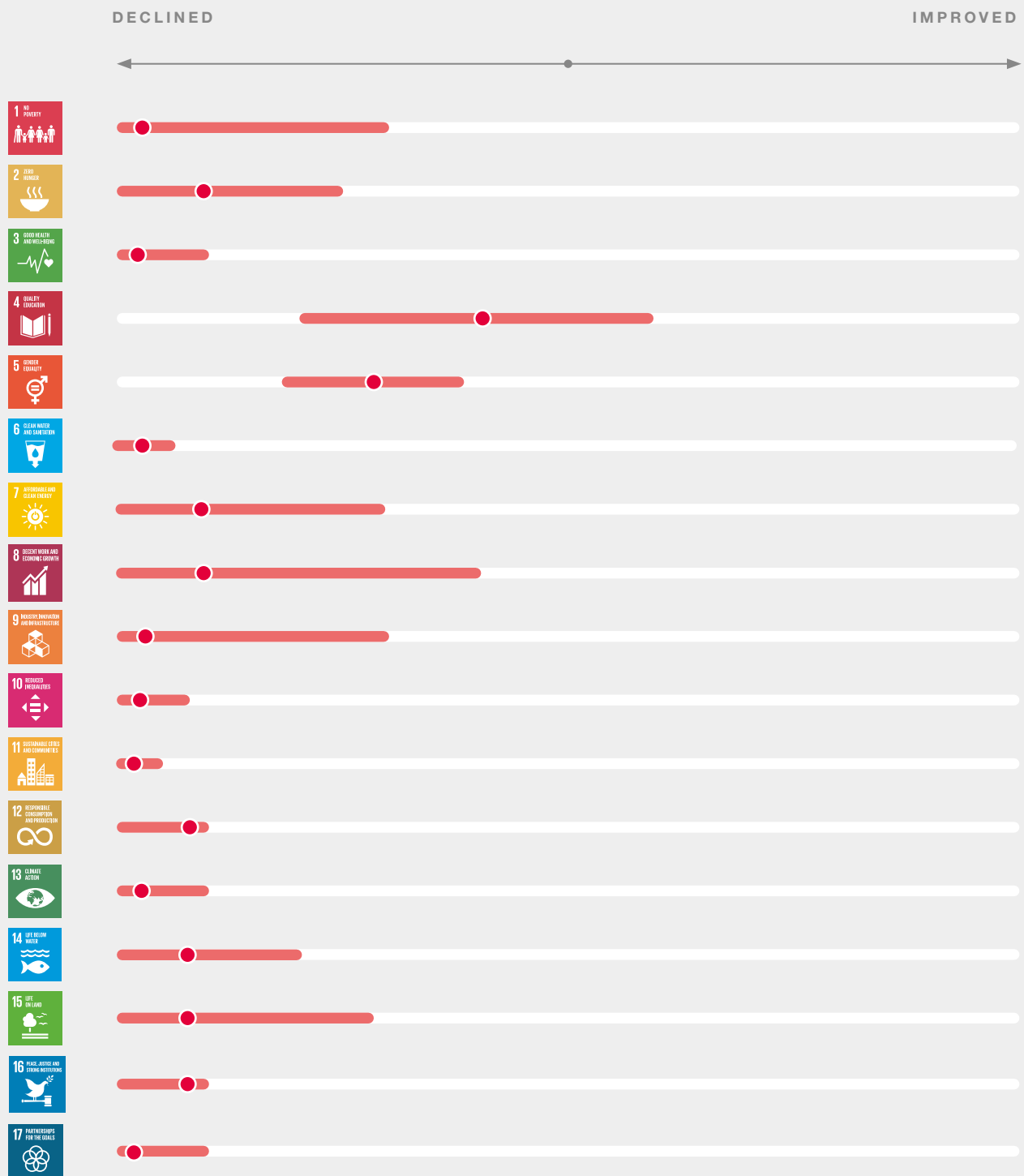
16

PEACE, JUSTICE AND STRONG INSTITUTIONS
30% of governments are democratically elected. Civil liberties are very low, press coverage is restricted, and freedom of expression is not allowed.

17

PARTNERSHIPS FOR THE GOALS
High global instability exists with national governing protocols. International bodies are not respected.

The world in 2050 is shaped by three decades of gradual societal improvement, coupled with half-hearted environmental stewardship.

Humans Inc.

For most people, life is as good as it's ever been. The planet, on the other hand, is not as healthy. In many ways, this period reflects a business-as-usual trajectory from 2020: the condition of humanity has continued to improve at the expense of the environment. Climate considerations have come third, subordinate to economic development and societal wellbeing. When coordinated action continued to falter on a global level, the super-economies settled for ambitious adaptation programmes. Future-proofing their own critical infrastructure while protecting their populations is a priority.

A sense of urgency for climate action is palpable, but "Why should we go first?" or "Not in My Backyard" dominates the dialogue. Thus, most national governments hesitate or delay the needed large-scale actions. The Netherlands, most of Scandinavia and Germany are a few places that have started trying to mitigate their impacts on the planet by introducing carbon-free transport weeks complete with penalties and fees for those who do not comply. Norway, Finland, Singapore, Costa Rica, and California have implemented Personal Carbon Limits. Many cities are taking an active role in developing urban agriculture in an attempt to secure their populations' food supplies and reduce reliance on surrounding areas. The Urban Farmers Union, founded in 2035, attempted to bring biodynamic farming into the mainstream. Despite these localised efforts, the exploitation of planetary resources continues almost unabated.

The amplitude and frequency of extreme weather events increased throughout the 2020s and 30s, with wetter wets and drier dries, hotter hots and colder colds. Major cities across the world repeatedly experienced flooding of their subway systems during the rainy seasons, another consequence of prioritising adaptation over mitigation. Cities are now finding ways to relocate their subway services above ground to ensure service. Persistent deforestation has contributed to shifting weather patterns causing severe, prolonged drought in India, the USA and Sub-Saharan Africa, leading to regional water shortages and unrest. Water scarcity is on the global agenda, with many cities – the latest being Lima – having run out of potable water at some point and turning to ocean-based desalinisation facilities and large-scale infrastructure and tunnelling systems to counteract water shortages. The decades leading up to 2050 are characterised by the declining relationship between nature and homo sapiens. In attempting to preserve our way of life, we have turned nature into an adversary that is striking climactic blows that coastlines cannot defend.

A somewhat converse and counter-intuitive development has taken place in some northern countries. Typically, cold and arid, these areas have seen significant improvement in agricultural growing conditions as global temperatures continue to rise. In Canada and Russia, large swathes of ice-prone land have become arable. Some northern nations have even advocated increasing carbon emissions to accelerate the expansion

The increase in global societal conditions has come at the cost of environmental degradation, due to a governmental focus on improving living conditions, access to education, jobs and resources.

Cities are now finding ways to relocate their subway services above ground to ensure service is continued.

of agricultural land and develop new areas for resource mining. These regions are becoming popular destinations for populations that have lost their habitable homeland to climate change.

The extreme weather has had knock on effects in unexpected areas. Seoul saw almost its entire electric vehicle fleet brought to a standstill in 2040 thanks to the coldest winter on record. The severe temperatures prevented the batteries from operating properly and had disastrous effects on public transit and critical services, such as emergency medical response whose fleet is entirely electrified.

A failure to maintain and update critical infrastructure for potential climate shocks and stresses has left many countries reeling with ailing infrastructure. Shanghai experienced prolonged blackouts in 2021 when temperatures remained above 50°C for days on end and its electrical grid came under significant pressure. Frequent superstorms overwhelmed New York City's waste water treatment system, leading to raw sewage spilling into the East River, rendering it unsuitable for human contact in 2025. The city has constructed digital walls displaying images of a clean waterfront, aimed at protecting residents from the unpleasant view; but not much can be done about the smell, especially in the humid summer months.

Following energy disruptions, China started its aggressive green energy programme. The country's progress in scaling renewable energy and automation has been significant. China now supplies many neighbouring countries with electricity and has become a full-service provider. Citing fiscal pressure, some

countries abandoned their energy networks completely, freeing them up to redistribute the money elsewhere with education spending seeing significant boosts.

The increase in global societal conditions has come at the cost of environmental degradation due to a governmental focus on improving living conditions, access to education, jobs and resources. Major advances have occurred in the former developing world where life expectancy has increased and infant mortality has decreased. Many nations have seen a renaissance of social state principles, with new welfare economies developed around the globe. Governments have provided new or upgraded housing, social services and Universal Basic Income (UBI) for those in need. Philanthropy has become mainstream.

Much welfare spending goes toward supporting citizens affected by climate disaster. As early as 2034, a series of new, internationally-synchronised building codes were piloted, aiming to increase the resilience of both existing building stock and new builds. The development of these codes is admired globally as an exemplar of cooperation between big business and public benefit organisations. The regulations were jointly developed by international re-assurance companies and leading global NGOs.

In many economies, societal health and wealth are centre stage. Governmental activities focus on protecting and improving societal conditions and the value lies in society-positive changes and economic inclusion. More people have been moved out of poverty than at any other time in human history; and global hunger and food deserts have decreased.

Life is good, for now.

9.9bn
global population

low wealth gap

2.0°C
increase

high global
cooperation

extreme weather

35%
clean energy

Timeline

2029
CHINA BECOMES THE FULL ENERGY SERVICES PROVIDER
China is the global leader in renewable energy which supplies 50% of domestic energy demand; it now sells energy and network services to neighbouring countries, some of which (Bangladesh was the first) have abandoned their own energy networks

2034
RESILIENCE BUILDING CODES PROTECT POPULATIONS
Resilience building codes are now implemented globally in an attempt to 'protect' the population from nature's temper

2038
FOOD LABELLING NOW INCLUDES FOOD MILES
The UN introduces food mile labelling across the globe; the newly founded Urban Farmers Union (UFU) holds its second meeting in Maputo to actively implement urban farming in densely populated urban areas; sole reliance on food supply from surrounding has become too risky to sustain urban populations

2020

2030
PERUVIANS VOTE FOR UBI
Peru votes for the introduction of Universal Basic Income, the first South American nation to do so

2035
ANOTHER FOOD CRISIS HITS MOZAMBIQUE
Food crisis resulting in severe famine hits Mozambique, forcing the population to rely heavily on food imports

**2040**
AMBULANCE FLEET STANDS STILL
Seoul experiences the coldest winter on record; its electric vehicle stock stands still as batteries cease to work in such extreme cold temperatures — this leads to major disruptions of critical services such as ambulance and fire

2047
CITRUS GROWING REGION EXPANDS
Citrus can now be grown successfully in Scandinavia and large parts of northern China and Russia

2048
LIMA RUNS DRY
Lima runs out of potable water, the third of the world's largest cities three years in a row

2050
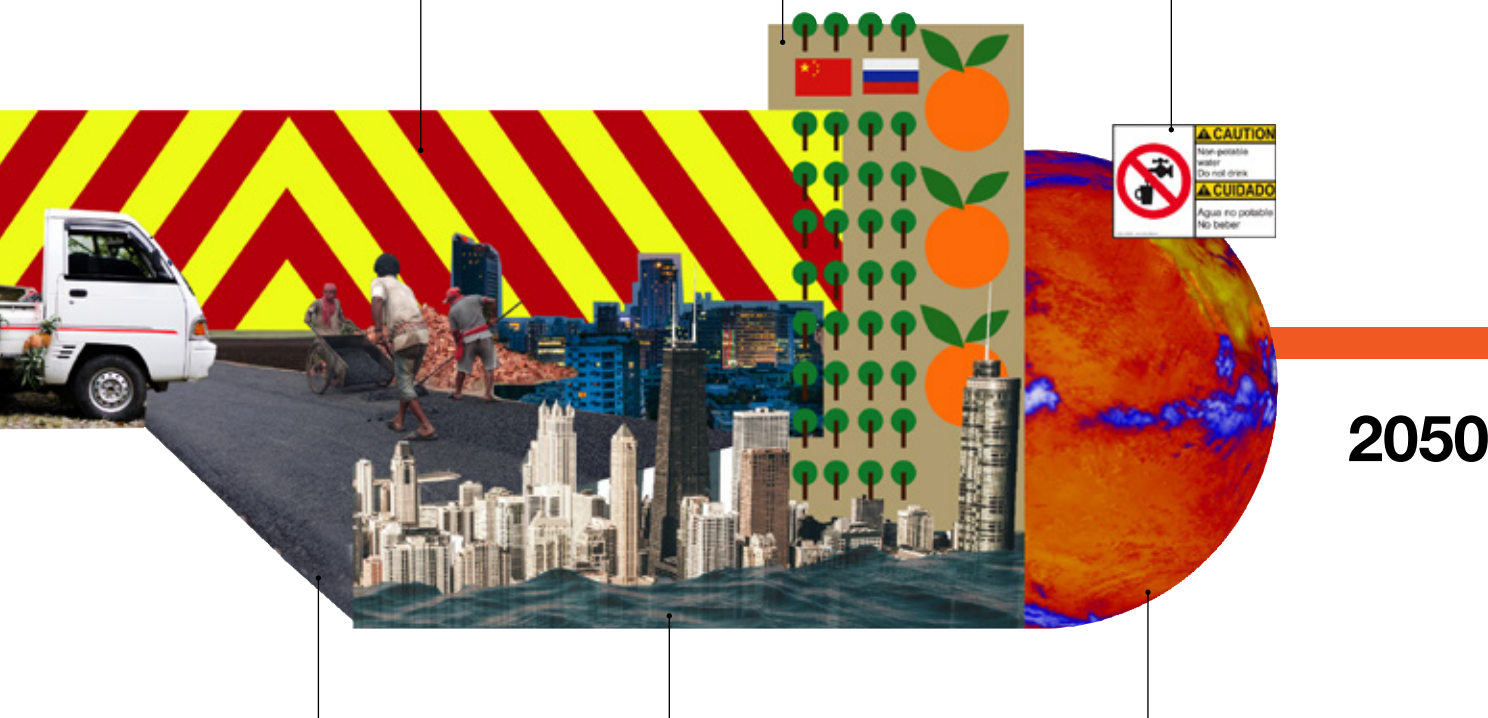
2039
WORKING CONDITIONS IMPROVE
Conditions for Bangladeshi workers are better than ever before thanks to the automation of many dangerous and repetitive jobs. The country now completely plugs in to the Chinese energy grid and abandoned its own to redistribute the capital toward educational endeavours

2045
ANOTHER METRO FLOODING
The failure of infrastructure systems is becoming the norm; Metro system flooding is commonplace; bridges across the Mississippi are collapsing and huge sewerage system failures have left major rivers unsuitable for human contact

2050
IPCC INCREASES TEMPERATURE THRESHOLD AGAIN
The IPCC continues to warn of the detrimental effects of crossing the 3°C global warming threshold for humanity and planetary systems – this threshold has been increased constantly in previous years as it became clear that more ambitious targets could not be achieved

Iqaluit, 2050

Yuka pulls her hood up as she walks as briskly as possible through Enterprise Square. Always busy, but rowdier than usual, she thinks.
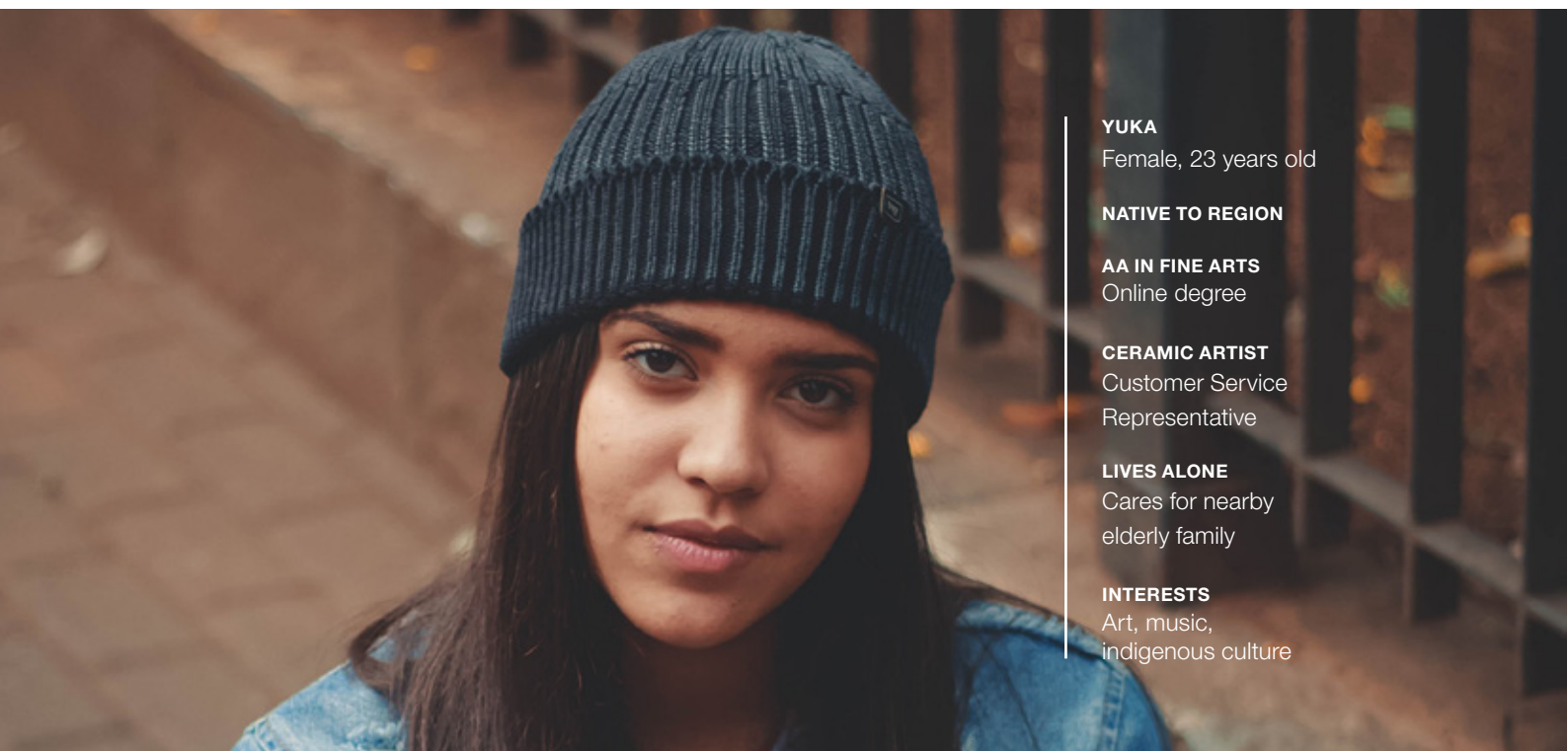
YUKA
Female, 23 years old

NATIVE TO REGION

AA IN FINE ARTS
Online degree

CERAMIC ARTIST
Customer Service
Representative

LIVES ALONE
Cares for nearby
elderly family

INTERESTS
Art, music,
indigenous culture

It was easy to forget that it didn't exist three years ago. Yuka weaves her way through groups of partying settlers, the smell of cheap beer and vomit making her wish she'd brought her government-issued breathing mask. No marsh fires today though, air quality alerts were all green and yellow when she left the house, the first time in weeks.

Some guy, huge and very drunk, probably a miner or a port worker, steps backwards without looking and nearly knocks her off her feet. Yuka regains her balance without slowing her pace, keeping her head down, and ignoring the disgruntled shouts from behind her. Don't even glance back, not worth the hassle. She usually avoids Enterprise Square unless, like today, she's

running late, and even when she does duck through here it's not usually this bad. It's not even 8am yet but the parties are still raging, and then Yuka remembers why and curses herself for being so careless. It was the solstice yesterday, 22 hours of continuous sunlight. The Midnight Sun parties will go on until dusk finally comes, or the settlers get tired and give up, whichever comes first.

Yuka understands the workers and their need to party, but their excess still infuriates her. She gets it, they come from all over the world, from places that are struggling, trying to find a new future for themselves. Oil workers from a Houston that's been abandoned to storm flooding, crop pickers from drought hit

Californian towns where the farms have shrivelled up and died. One day a factory worker came in to the shop to buy shoes and told her that the island he's from doesn't exist anymore, lost beneath the rising oceans. Yuka can't remember its name. But yeah, she gets it, they come here to find work and with the hope of finding clean air, open spaces, food that hasn't been grown in a lab. And money, lots of it. They want to let their hair down, celebrate their new fortune. Yuka just wishes sometimes that they'd do it somewhere else.

It feels worse now, but if she's honest it's been this way for as long as she can remember. At least since she finished high school. There's this weird cultural memory passed down from the elders of when the city was still just a village, when there were only a few thousand people here, most of them natives, and you knew everybody's name. But that was decades ago, before Yuka was even born. Now it's close to a million and rising. It's funny how you can feel nostalgic for a way of life you've never had, she thinks.

It all started when the snowfields melted, and when the sea stopped icing over. Suddenly there was fertile land to grow crops, and the ships could get in all year round. First, they built that huge automated container port just outside of the town, so they could bring goods in from China and Russia, and cheap oil from Alberta. Then the agricorps rolled in, snatching up the newly exposed, unclaimed prairies to grow fruit and crops under vast plastic tents. The port started getting bigger, more automated. The city started growing. At some point, when Yuka was still young, there was all that fuss when they found that large rare earth deposit out to the north west. Within a couple of years, the Chinese and Canadian mining companies had dropped enough money into the province to convince the leaders to let them turn Iqaluit into a Special Economic Zone, and from there it snowballed. Migrant workers from all over the world, though mainly from the rest of Canada, the US, Mexico, even Russia flooding in to work on the farms, in the mines, or the new electronics factories. Soon there were more containers flowing out of the port, sending cattle and fruit to the south where it's too dry to grow it anymore, and magnets and batteries to the cities where the power networks have been abandoned to the heat and floods.

Sure, it's changed a lot, but it's not all bad, Yuka reminds herself. In many ways she knows she is lucky. For a start, the increase in jobs has enabled investment in new infrastructure, lowered the cost of food and allowed for more leisure time. She only needs to work part time at the shop because the city became so rich that it now gives everyone a UBI payment every month. It's enough to cover rent, which means Yuka can spend a few hours every day in the pottery studio working on her ceramics. She obtained her college degree through completely free online courses that didn't cost her a penny, they even covered the journeys to the classes down in Vancouver. She's got an apartment in one of the new high-rise condos overlooking the bay, huge and all to herself, filled with all the latest gadgets and a TV the length of the wall. A little countertop robot prepares and cooks food, another vacuums and mops the floor. Plus, when the ice melted they dropped that big pipe into the sea, so that one day – when Yuka was a teenager – she suddenly had crazy-fast internet. All the bandwidth she could ever need, TV and movies from every continent, and for the first time Yuka felt connected to the world, outside Nunavut. She watched in ultra-high-def as people queued for drinking water in Rio and trudged through streets inundated by the ocean, yet again, in Miami. It made her realise that however crazy Iqaluit seemed, she was one of the lucky ones. It was changing, but it would always be her home.

Yuka is nearly at the store when a sound surprises her, and two women stumble from a doorway. One of them is coughing uncontrollably, spit and snot splattering the sidewalk. She crosses the street to give them a wide berth. It's probably nothing, probably just too much partying, but it unnerves her. She's heard stories from the agricultural workers of people getting sick with fevers that they never recover from, the rumours that the melting permafrost released something else along with the fertile ground: ancient diseases and prehistoric viruses that have been lying dormant for millennia. She pulls her hood up even higher, wishing again that she'd brought her breathing mask.

Key indicators

This page describes how the 17 UN SDGs would fare in this scenario. The scale indicates the level to which each UN SDG has been achieved, compared to 2019. The dark coloured circle is the mean level of achievement while the lighter coloured horizontal range indicates the variance.

1

NO POVERTY
Poverty is at an all-time low. Social state principles experience a renaissance with a new welfare economy. Automation and machine learning enable the implementation of a global universal basic income.

2

ZERO HUNGER
Climate change reduces crop yield in the world's breadbaskets, yet agricultural technology and GMOs improve crop resilience. Global hunger and food deserts have declined.

3

GOOD HEALTH AND WELL-BEING
Advances in medicine have increased life expectancy to 76 years and decreased infant mortality, yet extreme weather takes many lives, particularly in the Global South.

4

QUALITY EDUCATION
Education levels increase globally due to increased spending. 90% of adults' complete secondary education and 25% pursue tertiary.

5

GENDER EQUALITY
Unpaid care and domestic work is covered by welfare in most of the world. Economic development and education reduce fertility rates globally.

6

CLEAN WATER SANITATION
Vanishing glaciers have left billions of people water insecure. Reliance on desalination is commonplace globally.

7

AFFORDABLE AND CLEAN ENERGY
Reliance on fossil fuels is sustained yet renewables continue to increase in the share of generation. Advances in oil recovery technology expand reserves.

8

DECENT WORK AND ECONOMIC GROWTH
Job security is high and employment levels are healthy. People decide if and how they work.

9

INDUSTRY, INNOVATION AND INFRASTRUCTURE
Short-term thinking has rendered critical infrastructure vulnerable to changing climatic conditions. Investment in research and innovation is high yet focused on adaptation.

10

REDUCED INEQUALITY
The wealth gap has decreased due to effective development strategies, yet persistence of the extractive economy hurts the most marginalised.

11

SUSTAINABLE CITIES AND COMMUNITIES
Government spending on housing and city services is high, yet extreme weather events impact service provision.

12

RESPONSIBLE CONSUMPTION AND PRODUCTION
Economies are consumption-based.

13

CLIMATE ACTION
Arctic sea ice continues to be lost at 12% per decade, driving sea level rise. Decarbonisation actions are limited, and ineffective, and global temperature has exceeded the 2°C target.

14

LIFE BELOW WATER
Warmer sea temperatures disrupt ocean circulation patterns, altering global weather systems. Ocean acidification degrades northern fisheries.

15

LIFE ON LAND
Tropical forest cover has been reduced to 3% of what it would be without human destruction.
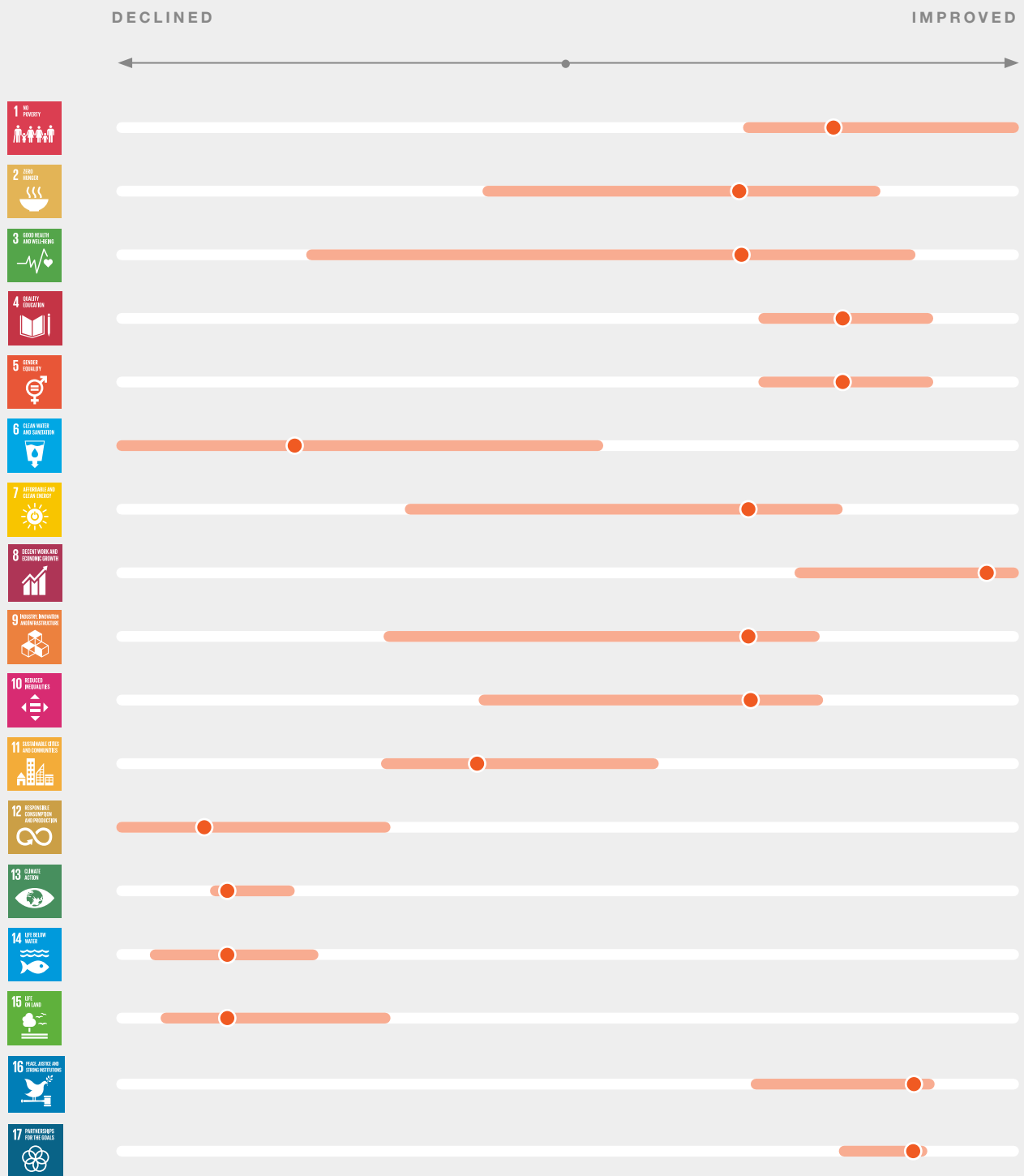
16

PEACE, JUSTICE AND STRONG INSTITUTIONS
65% of governments are democratically elected. Civil liberties and freedom of press are by and large upheld.

17

PARTNERSHIPS FOR THE GOALS
Interstate conflict is low due to global economic interdependence. International institutions have limited influence.

Comparisons

The four scenarios explored in this document highlight the benefits and challenges the world might face. While each have distinct outcomes, some trends persist in each.

Many impacts on Earth systems cannot be reversed within the next 30 years. Global warming and sea level rise, rapid urbanisation, global population growth, and rising education levels are experienced in all scenarios.

POST ANTHROPOCENE

People are living in harmony with the planet. The political and economic warning signs of unfettered consumption and persistent inequality prompted international and domestic collaboration to transform the status quo. Value-based economies that respect and integrate nature-based services motivate circular thinking, affecting resource use as well as intensive restoration of degraded natural capital. These advances have improved the quality of life for all species, and human equality is pursued through accessible healthcare, housing, and a stable living wage.

GREENTOCRACY

The protection and regeneration of Earth's systems is a global priority which all humans are obligated to adhere to. Strict consumption quotas, facilitated by invasive monitoring technology and authoritarian leadership, have forced a societal transition from a linear to a circular economy. Previously extracted resources make up a majority of the supply chain base; recycling is now integral to all material production. Extreme urban density has been enforced to preserve wild lands and the ecosystem services they provide. Meanwhile, civil liberties are suppressed to ensure humanity's support of the planetary agenda.

EXTINCTION EXPRESS

An obsession with pursuing economic growth has caught up with the planet and affected humanity's quality of life. The depletion of Earth's natural resources has necessitated the expansion of new extractive frontiers in space and the deep sea. The absence of social services makes coping with the health implications of air pollution, job insecurity, destruction of property from extreme weather events, and drought-induced food insecurity only possible for affluent people. Consequently, domestic and international political stability has broken down, and corporations determine policy.

HUMANS INC.

In the manifestation of our current people first trajectory, social progress is achieved at the cost of planetary health. A focus on technological innovation coupled with tight resource reserves drives efficiency, yet a consumption-based economy continues to degrade the planet. While quality of life has vastly improved for a majority of the population, humanity must adapt to an increasingly inhospitable environment. Social expenditure is high, supporting education, housing, healthcare, and job security as fundamental human rights, yet significant funds are used to offset financial loss from extreme weather-related damage.

9.6bn
global population

low wealth gap

1.3°C
increase

high global cooperation

stable weather

92%
clean energy

9.5bn
global population

high wealth gap

1.5°C
increase

medium global cooperation

stable weather

97%
clean energy

9.8bn
global population

high wealth gap

2.5°C
increase

low global cooperation

extreme weather

23%
clean energy

9.9bn
global population

low wealth gap

2.0°C
increase

high global cooperation

extreme weather

35%
clean energy

Conclusion

These four worlds, each extreme yet plausible, impart a valuable message: there is no one future state, just as there is no one present state.

THE FUTURE IS FICTION

Although there is no way to know what the world will look like in 30 years, the development of these four scenarios allows us to explore the possibilities of what our future could look like in 2050. These scenarios challenge our assumptions about the future and help us reimagine our role as a society.

THERE IS NO SINGULAR FUTURE STATE

Context is variable. Each scenario can, and likely will, exist in parallel; it's a matter of when, where, for how long, and for whom. As we look across the world today, many of the features described in these narratives already exist somewhere. Globally, we can and do exist in multiple and opposing states simultaneously: there are both strict and lax climate policies; increasing and decreasing birth rates; a rise in globalisation and a rise in nationalism; open and closed borders; the growth of urbanisation and low-density suburbs, the list goes on. The same is true for the future.

CHANGE IS CONSTANT

The journey will be eventful. The path to a Post Anthropocene world will be challenging and paved with conflicting agendas and undesirable events. While the ideal state, a future with positive planetary health and positive societal conditions, is one we hope and strive for, it will be a complex journey. The future, and the change that will get us there, begins today.

PARTICIPATION IS WHAT SHAPES OUR WORLD

In developing these scenarios, it became clear that today's actions play a significant role in the future we will experience. We all have the opportunity and responsibility to work towards a future that benefits us all. At Arup, our goal to shape a better world can be put into action every day. Through the projects we choose be part of, our community engagement activities, and our commitment to align our business to the UN SDGs, we aim to actively participate in the future that we want to see.

Through reading these visions of the future, we hope to have sparked your imagination, provoked insight, and showed you that the future is varied and uncertain. We hope that your curiosity is engaged and that these scenarios have made you think about what you want: for yourself, your family, your community and the next generation.

We hope to have helped you realise that each and every one of us has the ability to drive and impact change.

CONTRIBUTORS

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MEDIA INSPIRATION

POST ANTHROPOCENE

Metropolis (1927)
Soylent Green (1973)
Food Inc. (2008)
2081 (2009)
Brave New World (1932)

GREENTOCRACY

Ecotopia: The Notebooks
and Reports of William
Weston (1975)
Island (1962)

EXTINCTION EXPRESS

Interstellar (1975)
Mad Max (1979)
Code 46 (2003)
WALL·E (2008)
Idiocracy (2006)

HUMANS INC.

The Martian (2015)
Ready Player 1 (2018)
Blade Runner 2019 (2019)

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London: Marcin Nowak on Unsplash
Hong Kong: Yun Xu on Unsplash
Los Angeles: Pedro Marroquin on Unsplash
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Marin preserve (right): Ant Rozentsky
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CITIES ALIVE: DESIGNING FOR AGEING COMMUNITIES

Cities Alive: Designing for Ageing Communities identifies the specific needs of older residents and offers strategies and actions that cities and built environment professionals can take to make communities more age-friendly. The report synthesises these strategies into a vision for the future, showing how communities around the world can achieve this vision and empower their older residents to live happy and fulfilling lives.

Visit www.arup.com/ageingcommunities

DRIVERS OF CHANGE

Drivers of Change investigates the key global issues and trends driving change across the world. The Drivers of Change app examines the top 25 drivers of change impacting our societies and markets across 10 topics, from climate change to urbanisation to poverty.

Visit www.driversofchange.com

RETHINKING TIMBER BUILDINGS

Rethinking Timber Buildings considers the trends, technologies and new uses that are supporting a resurgence in this most ancient of building materials. Supported by historic precedents and recent global exemplars, Rethinking Timber Buildings examines seven different perspectives on the use of timber in building design and construction. It aims to consider a range of implications – including speed, quality, safety and human experience – relevant to anyone who has a stake in the materials we choose to build with.

Visit www.arup.com/rethinking-timber-buildings

CITIES ALIVE: TOWARDS A WALKING WORLD

The built environment needs to encourage healthier choices and we need to design physical activity back in to our everyday lives by incentivising and facilitating walking as a daily mode of transport. In addition to the host of health benefits, there are many economic benefits for developers, employers and retailers when it comes to walking. It's the lowest carbon, least polluting, cheapest and most reliable form of transport. It's a great social leveller and having people walking through urban spaces makes them safer for others and, best of all, it makes people happy.

Visit www.arup.com/citiesalive

ABOUT ARUP

Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. We offer a broad range of professional services that combine to make a difference to our clients and the communities in which we work.

We are truly global. From 80 offices in 35 countries our 15,000 planners, designers, engineers and consultants deliver innovative projects across the world with creativity and passion.

Founded in 1946 with an enduring set of values, our unique trust ownership fosters a distinctive culture and an intellectual independence that encourages collaborative working. This is reflected in everything we do, allowing us to develop meaningful ideas, help shape agendas and deliver results that frequently surpass the expectations of our clients.

The people at Arup are driven to find a better way and to deliver better solutions for our clients.

We shape a better world.

We live in a world characterised by increasing complexity and uncertainty. Climate change, biodiversity loss and resource scarcity threaten future generations. Meanwhile, digital technology, urbanisation and changing demographics will continue to transform communities, business and economies. The future will be determined by our ability to address today's environmental challenges and social changes and to meet the needs of nearly ten billion people by 2050.

2050 Scenarios: Four plausible futures presents visions for the world in 2050 to inform discussions on future social, technological, economic and environmental conditions. The scenarios are intended to develop a vocabulary and framework to help us envision different plausible futures. They help to identify and visualise what is worth striving for and what to avoid. Ultimately, they are intended to challenge assumptions and inform key decisions on the design and planning of the built environment.

ARUP