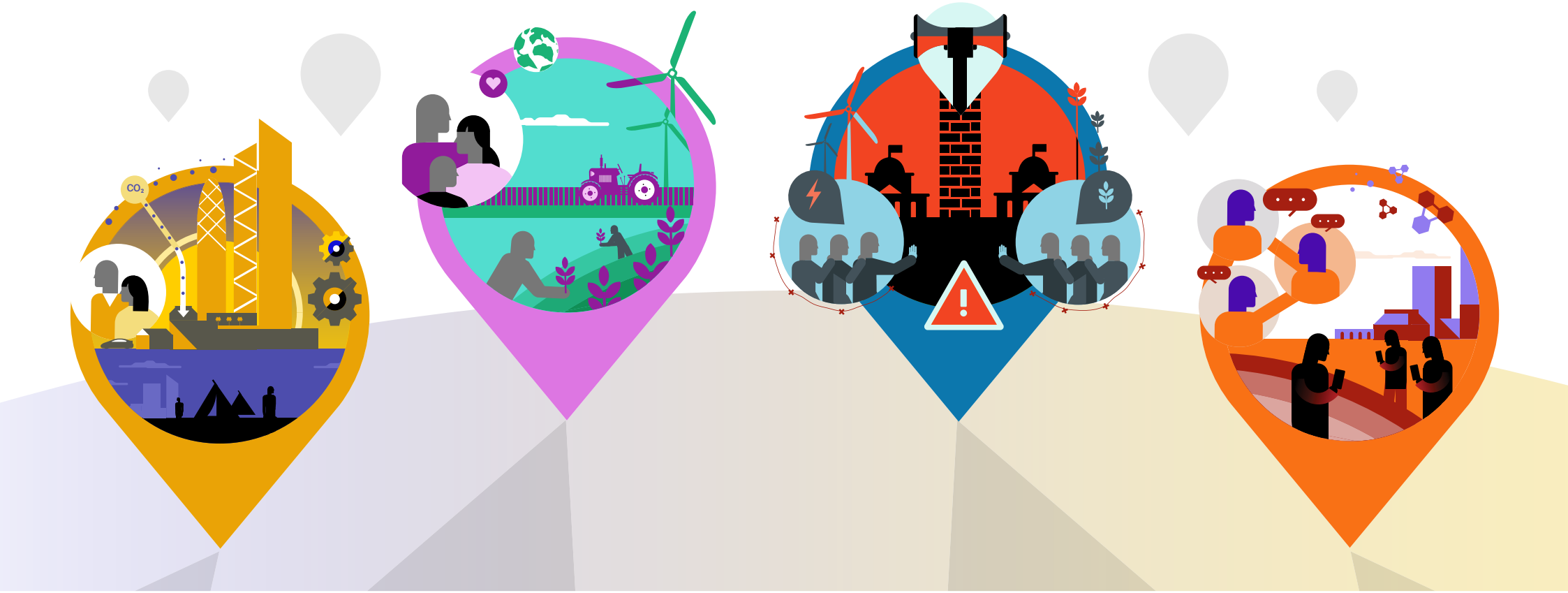
<2°C Futures

ADITYA BIRLA GROUP

2040 worlds on a trajectory to stay below two degrees centigrade of warming above pre-industrial levels



FORUM FOR THE FUTURE

Contents

Foreword

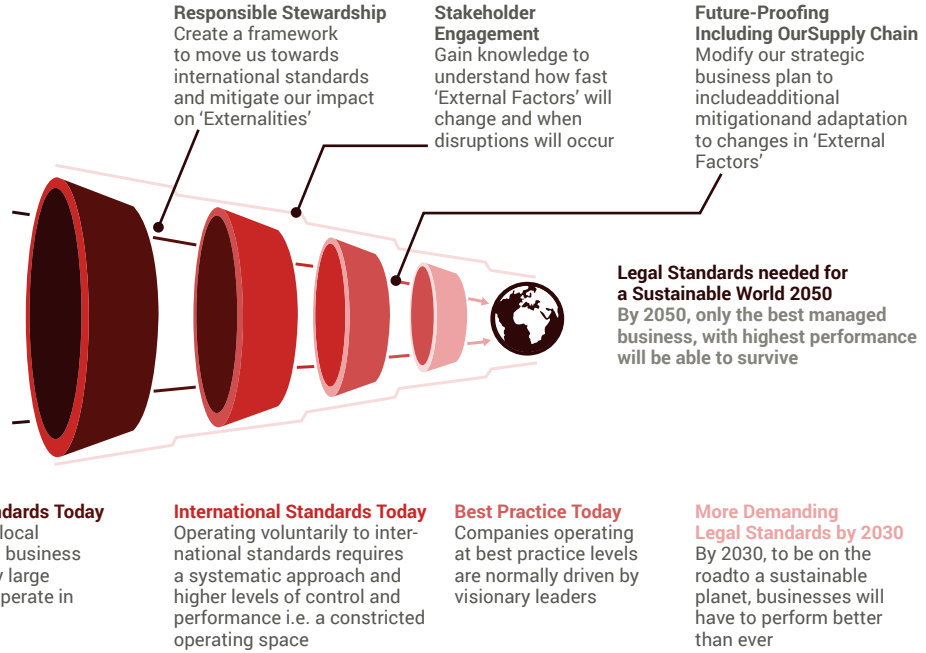
We as nations, as society and as a business have achieved tremendous progress in the last 100 years. But this progress is challenging the very nature of our ecosystem. We are now in a precarious situation. Staying under 2°C warming will not happen by itself and the dangers of not adhering to this commitment are significant.

We know that the transition to a 2°C trajectory is the best we can hope for, and that we at Aditya Birla Group have a role to play in making it happen. We also need to know that we can remain successful in the 2°C world we are creating. The ABG Sustainable Business Framework recognises that the space businesses have to operate within will shrink as legislation, coupled with other levers such as customer and citizen activism, will force change throughout value chains.

Our approach to the 2°C trajectory, and the commitments we make as a Group and as individual businesses, will to a large degree determine the trust we get from society. Trust is the ultimate and most precious accolade we can get in a challenging world.

By understanding what a <2°C world would look like and the transition scenarios to get there, we plan to build sustainable businesses that are even more successful than they are today.

D. Shivakumar, *Group Executive President, Aditya Birla Group and*
Tony Henshaw, *Chief Sustainability Officer, Aditya Birla Group*



Introduction

<2°C Futures is for those wishing to ensure their organisations can be successful as the world transitions to a zero carbon economy. Whilst this is not an easy path, it is both necessary and the best we can hope for, and one where competitiveness can be gained through innovation, proactive leadership and transformative management.

There is no business case beyond 2°C

The Paris Agreement on climate change commits us to keeping under two degrees centigrade of global warming beyond pre-industrial levels. The Stockholm Resilience Institute points out that beyond 2°C we risk becoming a “Hothouse Earth” which will stabilize at a global average of 4-5°C higher than pre-industrial temperatures[1]. Amongst other effects, this means a sea level 10-60 metres higher than today. New York, Bangkok, Jakarta, Dhaka, Singapore, Tel Aviv, Washington DC, Manila and Rio de Janeiro are amongst the cities that would be wiped out even at the lower 10-metre projection.

Not taking action means putting any business on a certain path to eventual collapse. For those looking to lead businesses that can be sustained in the long run, it is clear the business case exists only for action to stay below 2°C and successfully operate within this limit.

The challenge of staying below 2°C should not be underestimated. The planet has already warmed by at least 1°C[2]. The already stretching commitments made under the Paris Agreement risk taking us to a potentially hothouse inducing 2.7 - 3.7°C[3] .

Although it is an exponentially better future than a hothouse, a below 2°C trajectory will look very different to today and getting there will require fundamental change. It will for instance require a dramatic shift in our energy systems, how we use resources and how we calculate value. The sooner we ensure our businesses can operate in this new future, the better prepared we will be - ahead of the competition and the almost inevitable regulations coming our way.

[1] Steffen, W., Rockström, J., Richardson, K., Lenton, T.M., Folke, C., Liverman, D., Summerhayes, C.P., Barnosky, A.D, Cornell, S.E., Crucifix, M., Donges, J.F., Fetzer, I., Lade, S.J., Scheffer, M., Winkelmann, R., and Schellnhuber, H.J. (2018) Trajectories of the Earth System in the Anthropocene. Proceedings of the National Academy of Sciences (USA), DOI: 10.1073/pnas.1810141115

[2] Schurer, A.P., Mann, M.E., Hawkins, E., Tett, S.F.B., Hegerl, G.C., (2017) Importance of the pre-industrial baseline for likelihood of exceeding Paris goals Nature Climate Change volume7, pages563–567 (2017)

[3] See http://www.wri.org/blog/2015/11/latest-climate-commitments-how-much-will-world-warm-its-complicated Accessed August 2018

[4] https://science2017.globalchange.gov/

[5] http://www.climatechangenews.com/2018/02/13/leaked-draft-summary-un-special-report-1-5c-climate-goal-full/

How <2°C Futures can help you

<2°C Futures synthesises the leading scientific thinking on the physical im-pacts of climate change by 2040, and uses scenarios to explore the many possible levers that will push or pull us into a below two degree trajectory. It is a resource to help businesses and other organisations identify their future opp-ortunities and challenges, strategise, and take action to be successful on a below 2°C trajectory.

To help explore the <2°C Futures, and the implications for business and society, in this resource we summarise:

BASELINE 2040
What the science says is likely to have happened by 2040.

PHYSICAL BASELINE
The physical impacts of previous emissions already ‘baked into’ the system by 2040, based on projections from a number of sources, including the Fourth National Climate Assessment released by the U.S. Global Change Research Program in November 2017[4] and the January 2018 draft of the IPCC Special Report on 1.5°C[5] , as well as insights gained during expert interviews.

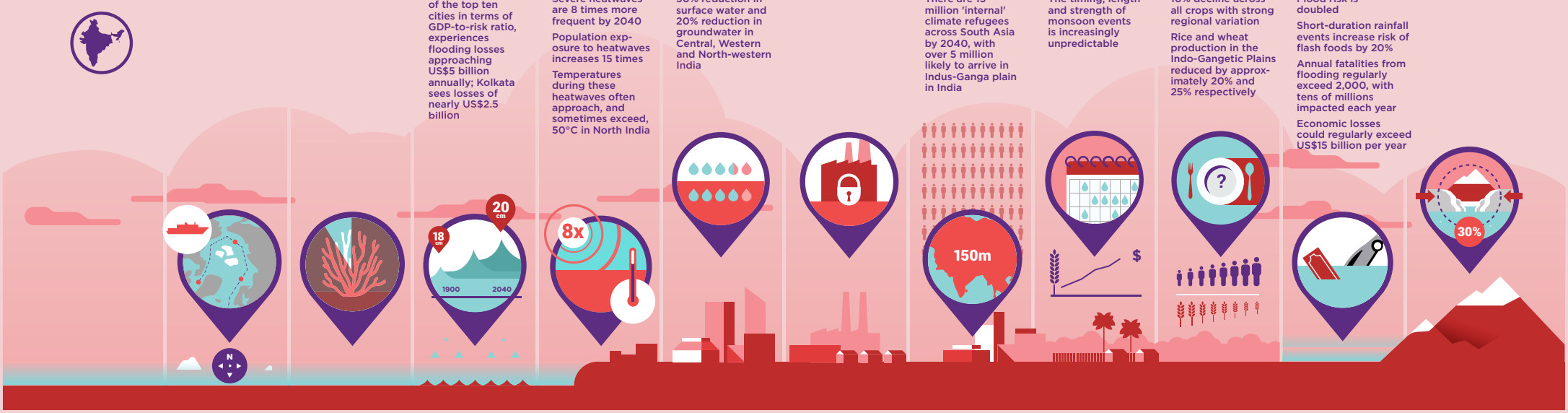
TRANSITION BASELINE
The transition levers we must have pulled to reduce and control emissions to a below 2°C trajectory. There is no one silver bullet, and the massive change required by 2040 across the globe will require a complex combination of the levers.

<2°C FUTURES: Four scenarios outlining what the business operating context could look like in 2040
The impacts on business will depend greatly on how the combination of levers is applied. In turn this will depend greatly on the socio-economic context. Many of the emissions trajectory models assume that the context in 2040, 2060 and 2100 will look similar to today. We know this is unlikely given the change we have seen over the previous 20, 40 and 80 years. For this reason, we need to understand how these levers could impact our businesses in different socioeconomic contexts: for instance, in a world of strict international governance what could we be forced to comply with and what incentives could we benefit from; and how can we therefore find success in that 2°C future? How might this differ if international governance splinters into the protectionist blocs already being signalled? The Scenarios will help you plan for these different <2°C Futures.

PHYSICAL BASELINE | Likely physical impacts of climate change by 2040

1.5 Globally Averaged Surface Temperature will likely be 1.5ºC warmer than pre-industrial times by 2040

	Declining Arctic Summer Ice	Ocean Health	Sea Level Rise	Heatwaves	Water Availability	Severe Winters	Migration	Monsoon	Agricultural Yield	Flooding	Himalayn Glacier Health
	First ever essentially sea ice-free Arctic in summer of 2035	90% of the world's coral reefs suffer from serious bleaching as a result of ocean warming and acidification Marine heatwaves are more frequent and severe	20cm by 2040 – on top of an 18cm rise since 1900	Heatwaves and droughts are more common and more severe across the globe	Increasing droughts and decrease in water availability	Intense winter cold snaps more common and more severe across the northern hemisphere	Over 150 million people displaced due to changing climate	Monsoons become increasingly uncertain and volatile	3.2% decrease in food availability per person by 2050 with most climate-food security related deaths likely in south and east Asia	Intense rainfall events – and associated flooding – are more common and more severe across the globe	Glacier volume shrinks by 30%, reducing snow accumulation and melt volumes
			Mumbai, as one of the top ten cities in terms of GDP-to-risk ratio, experiences flooding losses approaching US$5 billion annually; Kolkata sees losses of nearly US$2.5 billion	Severe heatwaves are 8 times more frequent by 2040 Population exposure to heatwaves increases 15 times Temperatures during these heatwaves often approach, and sometimes exceed, 50°C in North India	30% reduction in surface water and 20% reduction in groundwater in Central, Western and North-western India		There are 15 million 'internal' climate refugees across South Asia by 2040, with over 5 million likely to arrive in Indus-Ganga plain in India	The timing, length and strength of monsoon events is increasingly unpredictable	10% decline across all crops with strong regional variation Rice and wheat production in the Indo-Gangetic Plains reduced by approximately 20% and 25% respectively	Flood risk is doubled Short-duration rainfall events increase risk of flash foods by 20% Annual fatalities from flooding regularly exceed 2,000, with tens of millions impacted each year Economic losses could regularly exceed US$15 billion per year	
	New Arctic shipping routes open in summer Reduced reflection from the ice of the sun's rays could accelerate warming	500 million people worldwide dependent on tropical coral reefs for food and livelihood security face major nutrition and economic challenges Marine heatwaves cause CO2 releases from seagrasses, hindering efforts to reduce emission	Rapidly rising insurance costs, large scale disruption to logistics and points of sale	New capital investments, acquisitions, infrastructure will need to withstand greater heat ranges Greater risk of heat exhaustion, health threats to the workforce	Industry, agriculture, energy crops and households will compete for water as supply reduces Water stress fuelled communal tensions	Heavy snows and ice will disrupt supply chains and reduce productivity in the north of Europe and US	Increased demand for resources and services such as food, healthcare, shelter, education, livelihoods Greater migratory workforce and risk of improper governance	Unpredictable crop growing patterns Inflation of crop prices increases cost of food	Global population will likely increase somewhere in the region of 18% from 7.6bn to approx. 9bn in 2040 with India likely to grow 23% from 1.3bn to 1.6bn. Rising demand and falling food availability increases risk of malnutrition and starvation	Vulnerable populations are hardest hit Increase in property insurance costs contributing to higher costs of living, lower disposable income and demand for higher salaries Demand for resilient infrastructure materials increases	Reduced efficacy of downstream hydropower and agriculture yields
?	How could a new shipping route benefit your business?	Will your workforce be hit by nutrition challenges?	How would you safeguard coastal plant sites from rising sea level?	How do you think your business / plant might be affected due to consistent 'heat rests' for workforce?	Does your business rely heavily on supply of fresh water?	How might your supply chains be affected by more intense winter storms?	Will your area be able to cope with an influx of people?	How would an increasingly uncertain monsoon affect your supply chains and operations?	How might inflation due to food insecurity affect your operations?	How might rising insurance costs affect your balance sheet?	Would lower agriculture yields affect your raw material costs?



TRANSITION BASELINE | The levers we have to pull by 2040 to stay below 2°C

Global economy including India decarbonises at a rate of around 5% per year during the 2020s and 2030s

Fully Decarbonised Electricity System

- **2020s onwards** Rapid move away from coal
- **2020s and 2030s** Global renewables capacity addition as high as 1000 GW per year
- **2040 - 2060** Electricity generation is completely decarbonised
- **2050** Global RE installed capacity is 20,000 GW Solar, 1500 GW Wind
- **2050 - 2070** Electricity starts to dominate end-use energy consumption

- **2022** Thermal capacity peaks at 235GW, then declines rapidly
- **2025** 275GW of installed renewable energy capacity
- **2027** Renewable installed capacity increases to over 55% surpassing '40% by 2030' projection in INDC
- **2040** Thermal power is phased out completely

How will your electricity-intensive plants move away from thermal power?

Electrified Mobility

- **2030** Aviation emissions per kilometre travelled are 20% below 2013 levels - limiting the sector's emissions growth to 29%
- **2030s** Oil demand peaks and falls
- **2035** More than 50% of the world's cars are electric
- **2040 - 2050** Internal combustion engines are phased out globally

- **2030 onwards** All new road vehicles in India are electric

How would your businesses adapt to rising petrochemical prices and reduced availability?

Energy Efficiency in Buildings

- **From 2030** 5% of existing building stock is upgraded to zero carbon year-on-year In New York this means over 40,000 a year
- **2040** All new buildings around the world are zero carbon

How would you ensure that your current and new infrastructure is low carbon moving towards zero carbon?

Energy Efficiency in the Economy

- **2018 - 2040** Energy intensity of the global economy improves by 2-3% per year

- **2030** India energy intensity improvement exceeds INDC target of a 30-35% improvement over 2005 levels

Is your business on track of 3% year on year energy intensity improvement?

Heavy Industry

- **From 2015** At least 40% reduction in absolute emissions levels across all heavy industry globally

- **From 2015** At least 40% reduction in absolute emission levels across all heavy industry including cement, steel and aluminium
- **By 2040** All new investments are 'zero carbon'

How would you reduce emissions by 40% while still maintaining current production volumes?

Negative emissions technologies and land use

- **2020s** BioEnergy combined with Carbon Capture and Storage (BECCS) will require huge investment
- **2030** Significant global land requirements to grow feedstock for BECCS
- **2030s** Roll-out of BECCS up to 25GW per year
- **By 2050** Negative emissions technologies will extract and store atmospheric carbon. BECCS,reforestation and regenerative agriculture, enhanced weathering and direct air capture processes. Installed capacity up to 1700 GW removing 10 Gt CO2e annually.

- **By 2030** Afforestation programmes focus on maximum sequestration and surpass the '14% increase in sequestration by 2030' inferred within the INDC targets

How are you ensuring maximum sequestration on your property?

Net positive agriculture

- **2020s and 2030s** Agriculture becomes major focus to build climate resilience
- **By 2040** Agriculture has a 'net positive' contribution, releasing less carbon than it 'stores'

- **2020s** There are significant improvements in soil health

How could your business help increase the level of carbon in soil?

Investment

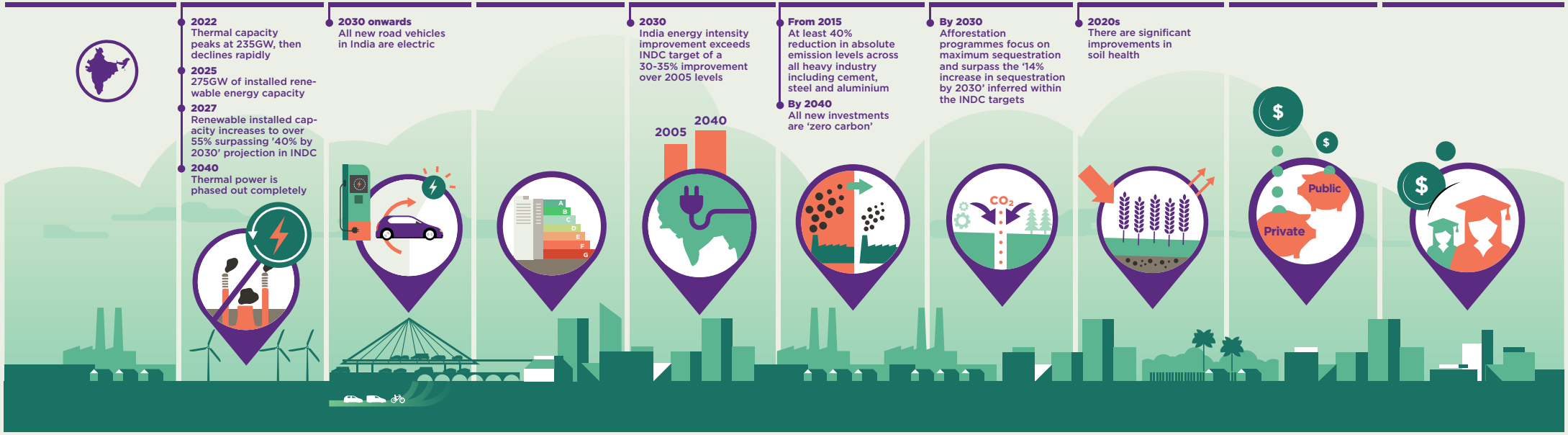
- **2020 onwards** $200 billion of public finance and $800 billion of private finance is invested in climate action each year
- **From 2020** Fossil fuel subsidies are slashed
- **By 2025** Fossil fuel subsidies are eliminated

Do your budgets incorporate investment needed for climate action?

Gender empowerment and education

- **2020s and 2030s** Investment in education, especially of women and girls, increases around the world

Are your recruitment and training approach aimed at increasing the number of women in work and senior positions?



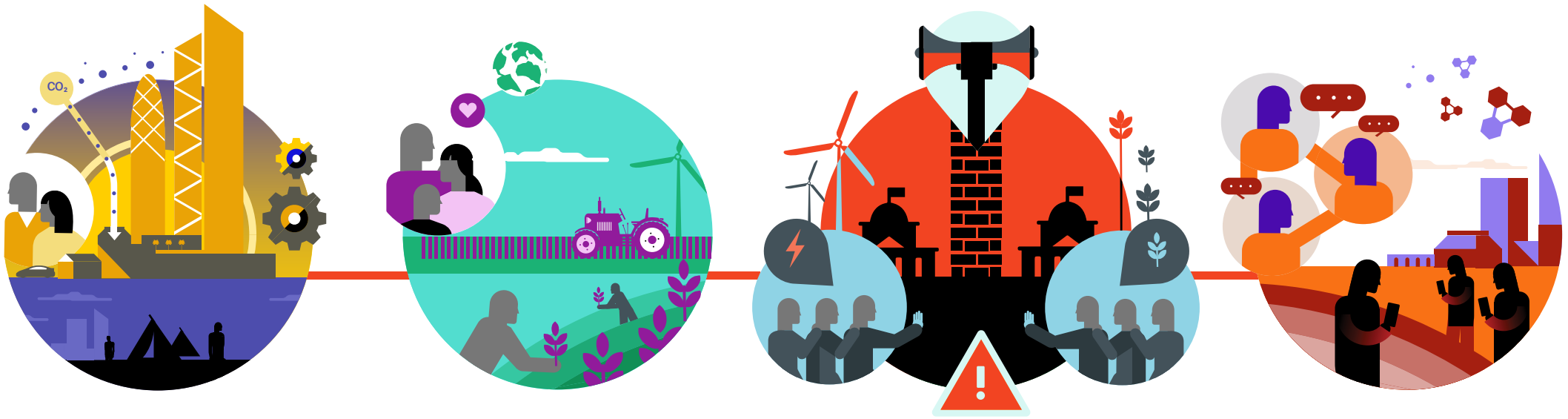
Scenarios

EFFICIENCY FIRST

REDEFINING PROGRESS

NEW PROTECTIONISM

SERVICE TRANSFORMATION



EFFICIENCY FIRST

A precarious globalised house of cards where constant and often risky technological innovation, motivated by high carbon prices, is just keeping us on track

2022

Global leaders agree transnational governance of food supplies following four years of record heatwaves and droughts

2023

"Woefully inadequate action" found by the Paris Agreement Global Stocktake on emissions reductions, adaptation efforts, financing and technology development

2025

Leap in Nationally Determined Contributions (NDC) commitments made by most countries as the toll of food shortage forces collaboration across borders on areas of high emissions

2029

The final wave of internationally coordinated compulsory purchases of agricultural land pushes all but a small number into urban areas

2030

The 'Robo Tax' trialled in China and Mexico is rolled out by many countries including India and the U.S.

2033

Masdar is finally complete along with the five new coastal desert megacities in Wave 1

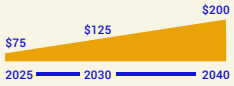
2036

Transnational company Wedunda is stripped of all assets and all senior management imprisoned within three months of being found inaccurately reporting emissions

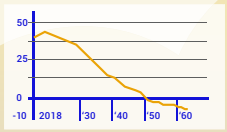
Carbon Emissions and Pricing Mechanisms

International carbon pricing regularly increases, with national carbon taxation on whole lifecycle emissions

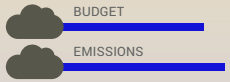
CARBON PRICE
Introduced universally at $75/tCO2e in 2025; reaching $125/tCO2e by 2030, and rising to $200/tCO2e in 2040



CARBON EMISSIONS / TRAJECTORY
Peak around 43 GtCO2e/year in 2021 reducing to 15 GtCO2e/year in 2040; net-negative emissions from 2050 onwards



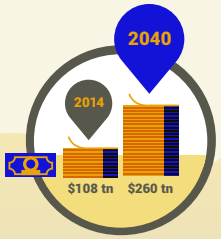
TOTAL CARBON EMISSIONS BETWEEN 2018 AND 2040
725 GtCO2e



Global Governance and Trade

Strengthened international governance and globalised trade

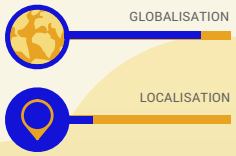
GDP
$260 trillion
- up from $108 trillion in 2014



Regulation and Policy

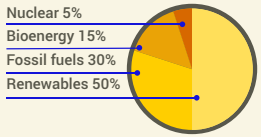
Internationally coordinated and policed, and enacted by business; Favours efficiency and 'big ticket' solutions

DEGREE OF GLOBALISATION
Overall the world is more globalised with seamless exchange of knowledge; some countries join global collaborations later



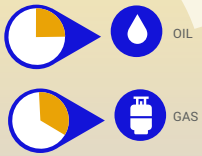
FOREST AREA
Increase of 25% over current level

Energy Mix in 2040



GLOBAL ENERGY DEMAND
20% increase over current level

MINING / PETROCHEMICALS PRODUCTION
Oil use is restricted to shipping and aviation, and under close international governance. Gas still used in industry and electricity production, but fossil fuel sector universally seen as a sector in decline

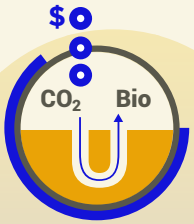


Innovation and Digital Paradigm

Focus on food production, negative emissions technologies, efficiency; Robotax on automation

GEOENGINEERING EXTENT
BECCS starts to come 'on-line' during the late 2030s, but more slowly than hoped and with many teething problems. Bioenergy investment carries on regardless.

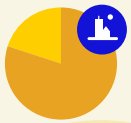
Multiple negative emissions technologies are attracting investment and being embraced



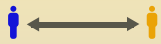
Lifestyle and Behaviour

Consumerist, individualist, high expectations placed on business and government action

URBANISATION
About 80% by 2050



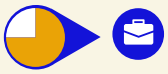
INEQUALITY
Income inequality persists or improves only slowly. Massive challenges of reducing vulnerability to societal and environmental changes remain



Social Cohesion

Current levels of social cohesion - with ethnic, religious and social tensions - continue to exist

TRUST IN BUSINESS
Trust in businesses is high - both among governments and citizens



TRUST IN INSTITUTIONS / GOVERNMENT
Trust in government and public institutions had to be rebuilt over the 2020s. Poorer populations generally trust less

DISPLACED PEOPLE
Very high, both due to unplanned and massive planned migration of rural areas into towns and cities to allow for big agrotech and forestry

TRANSITION BASELINE

PHYSICAL BASELINE

Efficiency First

2040

is a precarious globalised house of cards where constant and often risky technological innovation, motivated by high carbon prices, is just keeping us on a <2°C trajectory

THE GLOBAL CONTEXT IS ...
driven by strengthened international governance. High global carbon prices were introduced early, quickly ramped up and internationally monitored, driving an ultra-competitive business environment.

SOCIETY AND LIFESTYLES ARE ...
still unequal, consumerist and individualistic. Massive skilling and reskilling programmes exist to transition people from high carbon or automated sectors to mitigation and adaptation-related industries like renewable energy and resilient infrastructure.

BUSINESS IS ...
consolidated, working in partnership with government to accelerate the transition, after initial resistance. A healthy flow of international finance and higher risk tolerances sees entrepreneurial leaders claiming market share with low carbon innovations.

THE ECONOMY IS ...
growing steadily, aided by AI monitoring and real-time policy interventions. Massive growth in renewables, artificial nutrition sources and the construction of new cities driven by urbanisation policies is changing the sectoral balance in most countries.

ATTITUDES TO CLIMATE CHANGE ARE ...
purely competitive in the business world, with little moral stance. Individuals expect business and government to deliver the transition required. Governments cooperate internationally in recognition of the collective threats. With most now living in urban areas, they feel the heat even more as heatwaves intensify.

RESOURCES ARE ...
volatile, with high carbon prices shaping demand. The circular economy has grown, driven by economics. Massive swathes of land, transferred through compulsory purchase in many countries, are devoted to corporate-run intensive precision agriculture, carbon sequestration and bio-energy crops.

POLITICS IS ...
interwoven with business, and remains vulnerable to corruption in some countries. Most cities are run in public-private partnership. An international agreement governs the movement of climate refugees, but political and society tensions flare at peak events.

TECHNOLOGY IS ...
the main source of hope for reducing emissions and ensuring resilience. Huge investment and international collaboration on negative emissions technologies, efficiency and massive renewable energy and storage is proving constantly only just enough to stay on trajectory.

MUMBAI IS COPING WITH MORE INTENSE STORMS BY ...
taking part in the International Port Protection Mission which built up artificial and natural sea defences over the 2030s. Protection is only just sufficient however, and has to be constantly topped up by Talianceraj, the transnational parent of the corporate partner in Mumbai City Government.

REDEFINING PROGRESS

A digitally connected, yet highly localised world where priorities in many countries have shifted from rapid growth to healthier growth

2020 — The 'Facebook Inquests' begin, initiating a global rethink of the role of social media platforms

2022 — A major class-action climate lawsuit against 'big oil', brought forward by the Bangladesh youth movement, wins

2024 — Digital billionaire Nihal Akilesh elected to presidency of the U.S.

2025 — The World Bank's Wellbeing Index is launched; By 2030, it replaces GDP as the standard measure used to rank national performance

2026 — Bangladesh announces a managed retreat; mangrove restoration plan covering its entire coastline

2027 — More than 50% of UN signatory nations have some form of Universal Basic Income (UBI) scheme in place

2028 — International agreement on tax implementation enacted by major economies, making it illegal overnight for banks to transact with non-signatories

2030 — France formalises a maximum 4-day working week

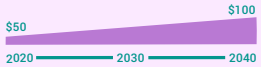
2035 — UN FAO data suggests that over 60% of the global population have adopted vegetarian diets

Car ownership drops to below 10% across cities worldwide

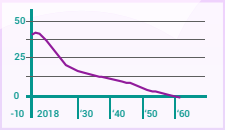
Carbon Emissions and Pricing Mechanisms

Used in places to catalyse change, but there is greater emphasis on 'full-cost accounting'

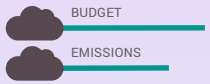
CARBON PRICE
Used and set locally, typically between $50 and $100/tCO2e during the 2020s and the 2030s



CARBON EMISSIONS / TRAJECTORY
Peak around 42 GtCO2e/year in 2020. Very steep reductions through the 2020s, dropping to 10 GtCO2e/year in 2040; net-negative emissions from 2060 onwards



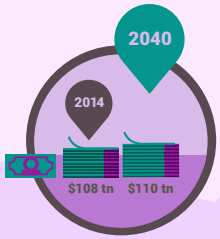
TOTAL CARBON EMISSIONS BETWEEN 2018 AND 2040
500 GtCO2e



Global Governance and Trade

Regionalised and localised trade, but a strong UN oversees global decarbonisation

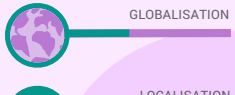
GDP
$110 trillion in 2040; GDP is no longer the metric of choice for country success



Regulation and Policy

A 'new localism' dominates. Favours small and medium - scale systemic solutions

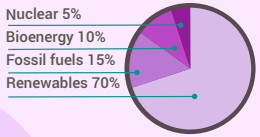
DEGREE OF GLOBALISATION
Mixed; Economies have become localised where possible, but international cooperation and information-sharing is high



FOREST AREA
25% increase in forest cover
(and huge increase in coastal mangroves)

Energy Mix in 2040

No new investment post-2025, but legacy plants still in operation; Small-scale renewables work alongside flagship mega-projects (eg, offshore wind) to dominate the electricity system



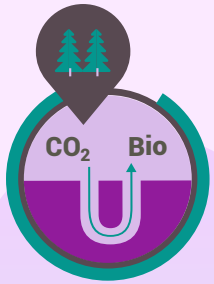
GLOBAL ENERGY DEMAND
40% decrease from 2018

MINING / PETROCHEMICALS PRODUCTION
Access to minerals forms the basis of remaining international trade; Petrochemical production is minimal

Innovation and Digital Paradigm

Highly digital, with seamless connectivity; Solutions are decentralised and expected to meet multiple objectives

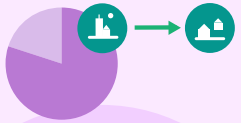
GEOENGINEERING EXTENT
Natural systems are used extensively to store carbon



Lifestyle and Behaviour

'Post-consumerist', focused on wellbeing and quality of life

URBANISATION
High, but new drive for simplicity leads to re-ruralisation

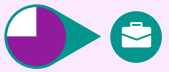


INEQUALITY
Lower than present

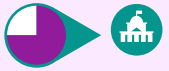
Social Cohesion

High

TRUST IN BUSINESS
High – given new legal obligations for business to demonstrate social purpose



TRUST IN INSTITUTIONS / GOVERNMENT
High



DISPLACED PEOPLE
High, but relatively strong support mechanisms in place

Redefining Progress

2040

is a digitally connected, yet highly localised world where priorities in many countries have shifted from rapid growth to healthier growth reflecting the changing aspirations of next generation leaders.

THE GLOBAL CONTEXT IS ...
shaped by a new localism that pervades politics and economics. Communities are more globally networked and empowered than ever, and business and technology are largely expected to serve society.

SOCIETY AND LIFESTYLES ARE ...
less consumerist and more about the experience as a status symbol. People monitor their wellness avidly, giving service providers access in order to live longer, healthier and more fulfilling lives. Veganism has exploded in popularity, and gender equality programmes are reaping benefits.

BUSINESS IS ...
dominated by purpose-led organisations and collective ownership models. Supply chains have shortened and are far more transparent as societal expectations dictate. Brands that demonstrate purpose have ferociously loyal customers. A 4-day work week is standard.

THE ECONOMY IS ...
a competition to top the World Bank's Wellbeing Index. Investors are driven by long term gain and 'restorative returns'. Carbon prices are not universally applied, though a nuanced form of full cost accounting is widely practiced. International trade focuses on strategic resources not available locally.

ATTITUDES TO CLIMATE CHANGE ARE ...
universally based on good understanding, leading to it being a priority for most societies. With more applied systems thinking however, climate change solutions are expected to address other societal priorities too. Increasing water scarcity is putting pressure on relations as well as crop yields.

RESOURCES ARE ...
where possible, put to multiple productive uses and being prioritised for restoration. Regenerative agriculture and biochar are widely embraced. High migration puts pressure on key hotspots however, with influxes driven from areas under managed retreat programmes away from flood and drought prone land.

POLITICS IS ...
more participatory than ever before. A new cadre of mayors, regional and state leaders have emerged. International cooperation is enabled through a strengthen UN, which also coordinates decarbonisation and adaptation support. Water resources and refugees remain sources of tension. In a few places separatist movements try to put up barriers to protect resources.

TECHNOLOGY IS ...
massively enabling efficiency. One core device allows people to control almost every aspects of their lives, and to radiate data to chosen service providers. The energy system is a true mix of small, medium and large renewables and, with the help of IoT, cities now promote cycling, walking and public transport over private vehicle ownership.

MUMBAI IS COPING WITH MORE INTENSE STORMS BY ...
having well implemented local incident plans, and a strong emphasis on restoration in the mangroves to protect the coastline. Damage to property is still significant however, and the costs have to be collectively managed within communities, using local financing mechanisms.

NEW PROTECTIONISM

A splintered world of protectionist blocs, where tackling climate change is a matter of national security

2022 — India rolls out a social credit reputation rating system linked to the Aadhaar identification number

2020s — Jordan, Syria and Yemen face ongoing altercations fuelled by a shortage of water

2023 — Italy refuses to ratify a long fought and precarious agreement on quotas for refugees

2028 — The UN experiences its lowest year of funding in 20 years as members cite home security needs as reasons for reducing contributions

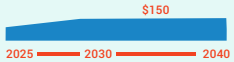
2031 — China presents the 5th Zero Hero award to Fei Hung, who tops the low carbon living register of citizens

2034 — Accusations fly at an international convention as Concentrated Solar Power (CSP) facilities almost identical to India's top-secret Desert Bloom facility are found in Pakistan

Carbon Emissions and Pricing Mechanisms

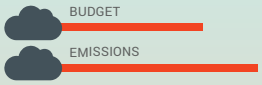
No internationally ratified system, but different versions are used heavily within countries and regional blocs

CARBON PRICE
No global carbon price, but adopted in certain countries/blocs during late 2020s/2030s (typically around $150/tCO2e through the 2030s)



CARBON EMISSIONS / TRAJECTORY
Peak around 45 GtCO2e/year in 2025, falling to 15GtCO2e/year in 2040. Steep reduction in the 2030s (as carbon 'space race' ramps up); Intention to be net-negative 2055 onwards (with frantic investment in NETs/geoengineering)

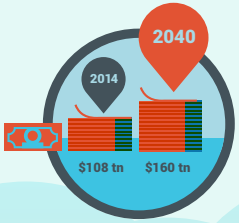
TOTAL CARBON EMISSIONS BETWEEN 2018 AND 2040
825 GtCO2e



Global Governance and Trade

Protectionist blocs and bilateral resource deals

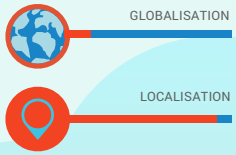
GDP
$160 trillion in 2040



Regulation and Policy

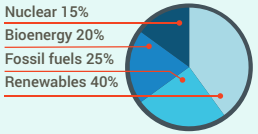
Draconian. Favours large, centralised, state-backed solutions

DEGREE OF GLOBALISATION
Low



FOREST AREA
Increases from 2025 onwards as 'national forests' are deemed essential for carbon storage and/or BECCS

Energy Mix in 2040



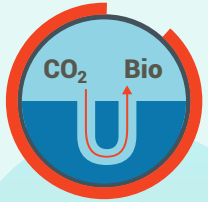
GLOBAL ENERGY DEMAND
5% reduction from current levels by 2040

MINING / PETROCHEMICALS PRODUCTION
Access to minerals forms the basis of many bilateral deals; Gas dominates the 'fossil fuel sector' and is still used in industry and electricity production, albeit typically with CCS

Innovation and Digital Paradigm

Focused on national security. Geoengineering, resource substitution, biotech and surveillance are priorities

GEOENGINEERING EXTENT
High, but uncoordinated



Lifestyle and Behaviour

Heavily controlled by the state, with 'patriotic' low-carbon behaviour rewarded

URBANISATION
Mixed. Current trends continue, but there are active efforts by some states to prevent rural 'out-migration' by keeping agriculture labour-intensive

INEQUALITY
High

Social Cohesion

High within homogeneous ethnic and religious groupings, but very poor between such groups

TRUST IN BUSINESS
High

TRUST IN INSTITUTIONS / GOVERNMENT
High, despite draconian policies

DISPLACED PEOPLE
High

TRANSITION BASELINE

PHYSICAL BASELINE

New Protectionism

2040

is a splintered world of protectionist blocs, where tackling climate change is a matter of national security. Cultures continue to fragment along religious, values and ethnic lines.

THE GLOBAL CONTEXT IS ...
dominated by strongmen-style leaders with 'national interest' being used to justify increasingly draconian measures that focus on security and access to resources. Hard borders stem the international flow of climate refugees, with an underfunded UN powerless to intervene.

SOCIETY AND LIFESTYLES ARE ...
largely dictated by government. Individuals are closely monitored in the name of patriotic duty, and National Reputation Rating Schemes determine social status in many countries. Everything from diet, health, technology and lifestyle choices, and even child-bearing, is watched and rated.

BUSINESS IS ...
dominated by large, state-owned 'national businesses' following a series of pseudo nationalisations where governments took control of assets deemed to be in the national interest. A few multi-nationals resisted protectionism and restrictions on trade, now only operating in relatively liberal countries.

THE ECONOMY IS ...
a network of strategic bilateral trade deals designed to ensure access to resources. Borders have been closed to non-sanctioned rivals. Cybercrime is rife and there is a flagrant disregard for IP rights in the name of national security.

ATTITUDES TO CLIMATE CHANGE ARE ...
focused on how it challenges national security, culture and integrity. The need to decarbonise quickly is now used to justify everything from international relations to highly invasive government control over individual behaviour. Some countries are suffering with falling crop yields as weather patterns change and water scarcity increases.

RESOURCES ARE ...
the subject of intense competition that frequently erupts into violence. Water wars were a defining feature of the 2030s across Asia and Africa. Countries and regions with limited resources, skills or capital to trade find little international sympathy or cooperation.

POLITICS IS ...
about using hard line policy to control business and how people live their lives. The cost to individual liberty is high. Access to resources is high on the agenda, but it has become a world of 'each for their own' with the most vulnerable rarely represented.

TECHNOLOGY IS ...
the tool in a decarbonisation and adaptation arms race that focuses on building or protecting national security. Large, centralised and state-backed decarbonisation and adaptation solutions dominate. Carbon capture and storage or utilisation (CCS/U) received huge investment in the 2020s and 2030s, but impact at scale is still elusive.

MUMBAI IS COPING WITH MORE INTENSE STORMS BY ...
making massive efforts to protect the flagship city. The ongoing costs of strengthening sea defences are becom-ing hard to justify, and a managed retreat plan has been tabled, proposing the sacrifice of a number of low-lying neighbourhoods over to mangroves and wetlands restoration and new defences.

SERVICE TRANSFORMATION

A world where the mainstreaming of access over ownership has happened quickly, and globally-applied, individual carbon budgets are traded and tracked

2023 — CarbonCoin cryptocurrency overtakes BitCoin

2025 — Unprecedented agreement during the climate ratchetting process following 7 years of intense fires, droughts and floods

2030 — Global carbon market is reformed and linked to CarbonCoin, with the introduction of tradeable, globally identical individual quotas

2033 — The first put options for Miami housing go on sale as mainstream insurers refuse to cover a third of the city

2037 — McDonalds' menu across the world is entirely meat-free

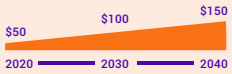
2038 — India is now 70% urbanised from approximately 33% in 2017

VirtuTrip floats at record-breaking valuation as virtual tourism booms

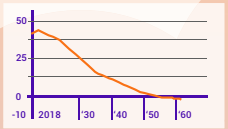
Carbon Emissions and Pricing Mechanisms

CarbonCoin global crypto-currency market with tradeable individual quotas and annual ratchet down

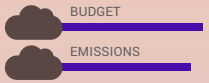
CARBON PRICE
Introduced universally at $50/tCO2e in 2020; reaching $100/tCO2e by 2030, and rising to $150/tCO2e in 2040



CARBON EMISSIONS / TRAJECTORY
Emissions peak at around 42 GtCO2e/year in 2020 and decline to around 12 GtCO2e/year in 2040; with net-negative emissions from 2055 onwards. Steady decline in emissions in line with pre-set budgets



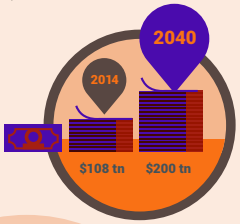
TOTAL CARBON EMISSIONS BETWEEN 2018 AND 2040
650 GtCO2e



Global Governance and Trade

Internationalist technocratic governance

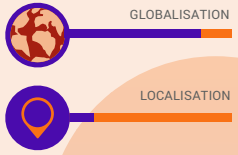
GDP
$200 trillion in 2040



Regulation and Policy

Favours innovation, uses AI modelling to anticipate outcomes and adapt

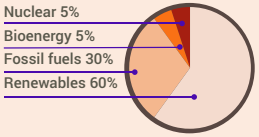
DEGREE OF GLOBALISATION
Strong global collaborations right from 2020



FOREST AREA
10% increase in forest cover

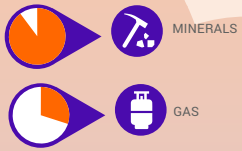
Energy Mix in 2040

With medium - and small scale solar dominating electricity production



GLOBAL ENERGY DEMAND
20% increase over current level

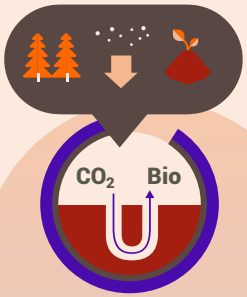
MINING / PETROCHEMICALS PRODUCTION
Minerals are extensively reused; Gas still being used in industry and for electricity generation sector in declinein decline



Innovation and Digital Paradigm

High degree of virtualisation, decentralised technology

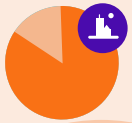
GEOENGINEERING EXTENT
Direct air capture, reforestation and biochar to the fore



Lifestyle and Behaviour

Access over ownership, service living paradigm

URBANISATION
75% by 2050 and more than 85% by 2100

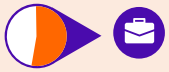


INEQUALITY
Income and social inequality decreases but still persists in low income countries; overall inequality is the second lowest among the four scenarios

Social Cohesion

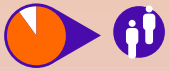
Current levels of social cohesion - with ethnic, religious and social tensions - continue to exist

TRUST IN BUSINESS
Medium. People are sceptical due to reduced face-to-face interactions; people believe that business is led by policy and regulation, rather than leading from the front



TRUST IN INSTITUTIONS / GOVERNMENT
Medium to high; Citizens appreciate open policies but are critical of still-prevalent inequality

DISPLACED PEOPLE
High, individually tracked and directed



TRANSITION BASELINE

PHYSICAL BASELINE

Service Transformation

2040

is experience-led. Service-based living, the mainstreaming of access over own-ership, has happened quickly, and globally-applied, individual carbon budgets are traded and tracked.

THE GLOBAL CONTEXT IS ...
highly urbanised and globally networked. The centre of economic and political power has shifted east since the 2020s and China now dominates a technocratic internationalist framework.

SOCIETY AND LIFESTYLES ARE ...
based on subscriptions to services for everything from mobility to housing to wellbeing. Personal carbon trading on digital platforms is the new normal, and has to some degree reduced inequality as the poorer, less carbon intense lifestyles sell their quotas to the rich. Annual reductions in quotas are a source of tension. Virtual tourism and vegetarianism are default choices.

BUSINESS IS ...
in a state of disruptive transition led by tech-enabled innovators providing affordable access to service-based living. Finance innovation, enabled by decentralised blockchain, such as put options on property in less resilient cities and the pooling of smallholder land has changed the flow of capital.

THE ECONOMY IS ...
dominated by innovative and complex global carbon markets based on mature blockchain platforms. The low carbon economy has been a net creator of jobs thanks to constant upgrading of infrastructure and reconfiguring of cities. Carbon intensive industries are in steep decline. The global knowledge economy is more accessible than ever before.

ATTITUDES TO CLIMATE CHANGE ARE ...
accepting of the reality and driven by a desire to get 'out of the danger zone'. Refugees are individually tracked and funnelled towards special humanitarian zones serviced by international agencies. Where they settle is strictly governed. Keeping many temporary and permanent settlements alike at a safe and comfort-able temperature is proving a challenge.

RESOURCES ARE ...
stretched, particularly rare earth metals and natural fibres. The circular economy is mainstream and provides a significant source of jobs. 3D printing and recycled concrete, design for disassembly and reuse feature heavily due to a need for 'relocatable communities'. Water shortages and unpredictable deluges pose huge challenges for agriculture in many locations across the world despite significant innovation.

POLITICS IS ...
utilitarian, focusing on what 'produces results', often replacing subsidies for x-prize style funding or results-based smart contracts. Transparency is shrinking the space for corruption. A politically popular basic level of universal services for all has been established, helped by individual carbon quotas.

TECHNOLOGY IS ...
largely decentralised. Trustworthy verification is the subject of an arms race between AI technologies. Biotech is applied in finding resilient crops faster, and to free up land for agriculture by brewing inputs for textiles, leather and medicines. Energy generation is de-centralised, but distribution is centrally managed by a few smart grid companies. Virtualisation has replaced the majority of flights, which are now prohibitively expensive. Shipping has electrified, and volumes are lower due to shorter supply chains.

MUMBAI IS COPING WITH MORE INTENSE STORMS BY ...
having reconfigured the city over the course of the 2030s, shifting large populations away from areas prone to inundation. The service living concept is put to its test with wealthy families demanding rapid relocation to lower risk areas, but low income households facing lengthy delays and slow re-provision.

Implications

Together, the baselines and scenarios suggest that businesses set to be successful in a below 2°C future need to be ready for a complex picture of mutually reinforcing changes including:

- A tough policy landscape and robust implementation
- The end of coal
- An huge transformation in the built environment
- A step change in agriculture and food
- A mobility revolution
- New materials and minerals to the fore
- Detailed monitoring of corporate, and even individual, behaviour
- The emergence of radically different governance and business models
- A change in land use on a massive scale for protection, sequestration and energy
- Sea-level rise that poses serious challenges for low-lying cities
- Hotter, more frequent heatwaves and intense flooding
- Increasing migration, particularly from water-stressed areas
- Tackling poverty will have become critical to all
- An acceptance that technology alone will not save us

With climate change impacts already demonstrating how unprepared we are globally, and the timetable for action being sooner than most believe, the time for action is now if we want our businesses to continue to be successful. As some of the leading experts say: "There will always be those who hide their heads in the sand and ignore the global risks of climate change. But there are many more of us committed to overcoming this inertia." Finding business value on a below 2°C trajectory is at the least imperative to manage our risks, and at best a source of transformational competitive advantage — and probably sooner than most think.

FORUM FOR THE FUTURE

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