Disclaimer: The state of knowledge reflected here is grounded in an assessment performed in the IPCC Special Report on Global Warming of 1.5°C that was completed in 2018 and that the Working Group I, II and III reports will provide an updated state of knowledge, including on the feasibility of mitigation implementation.

ipcc
INTERGOVERNMENTAL PANEL ON climate change
Working Group I (WGI) - The Physical Science Basis

WORLDS APART

A STORY OF THREE POSSIBLE WARMER WORLDS

The future will look different no matter what — just how different is our choice

Because the decisions we make today determine the world we get tomorrow

There are many doors to many possible worlds

SPECIAL REPORT ON GLOBAL WARMING OF 1.5°C, 2018

‘LIMITING GLOBAL WARMING TO 1.5°C REQUIRES RAPID, FAR-REACHING AND UNPRECEDENTED CHANGES IN ALL ASPECTS OF SOCIETY’

- Global net zero CO_2 emissions by 2050 (carbon neutrality)
- CO_2 emissions need to decline 40-60% from 2010 levels by 2030
- Renewables supplying 70-85% of global electricity by 2050
- Required energy system investment of around $2.4 trillion every year until 2035

THERE IS NO SINGLE ‘1.5°C WARMER WORLD’, BUT SOME PATHS DIVERGE MORE FROM THE WORLD AS WE KNOW IT TODAY

LATE, UNCOORDINATED ACTION
One possible storyline from among worst case scenarios

DELAYED, DECISIVE ACTION
One possible storyline from among mid-case scenarios

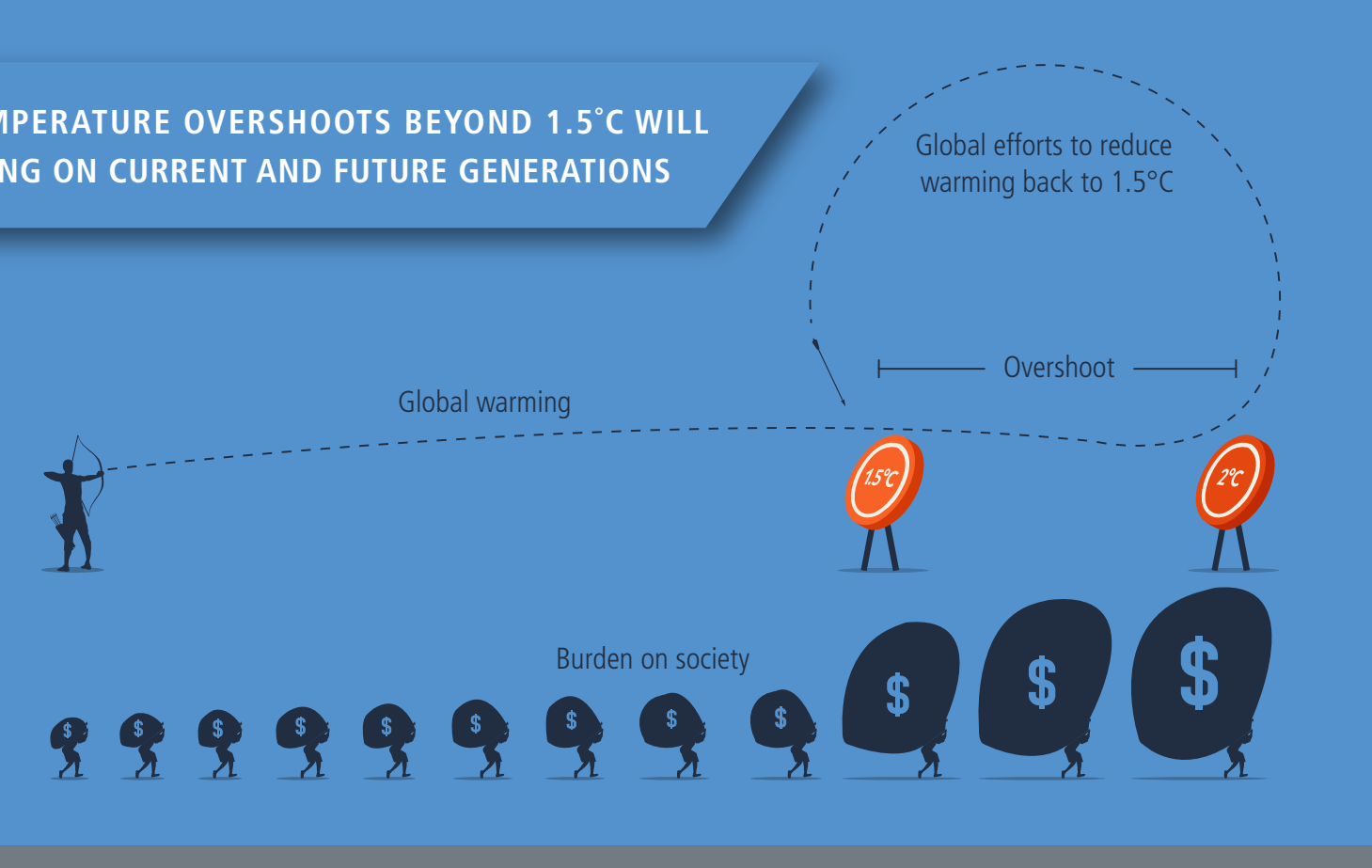
EARLY, EFFECTIVE ACTION
One possible storyline from among best case scenarios

But first, a little more context

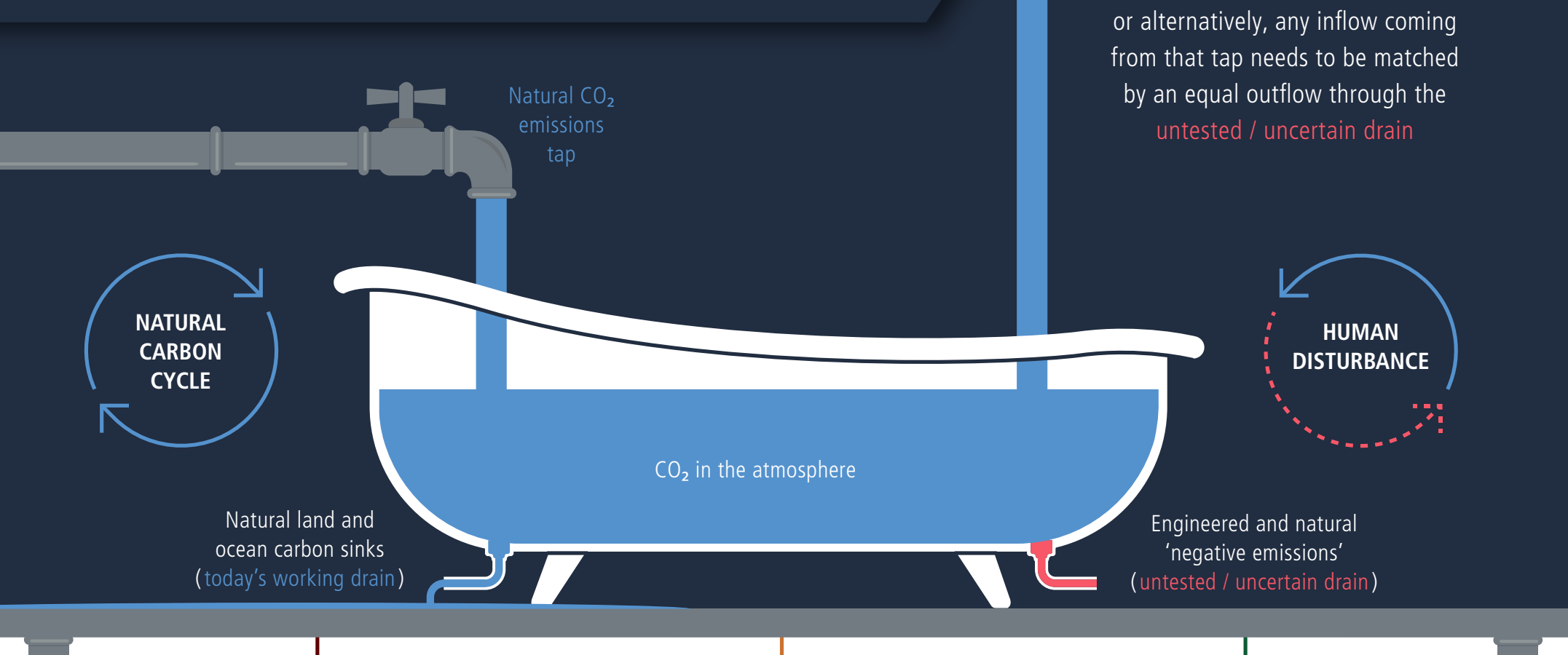
ONLY WORLDS WITH NO- OR LOW-TEMPERATURE OVERSHOOTS BEYOND 1.5°C WILL PREVENT SUBSTANTIAL BURDENS FALLING ON CURRENT AND FUTURE GENERATIONS

The greater any overshoot, the greater the efforts needed to return global average temperature increase to 1.5°C — using ‘negative emissions’

But negative emissions at the required scale are still very uncertain



EARTH’S ATMOSPHERE IS LIKE A BATHTUB FILLING UP WITH CO_2 EMISSIONS


Human-made CO_2 emissions tap
Natural CO_2 emissions tap
NATURAL CARBON CYCLE
HUMAN DISTURBANCE
CO_2 in the atmosphere
Natural land and ocean carbon sinks (today’s working drain)
Engineered and natural ‘negative emissions’ (untested / uncertain drain)

To halt warming, we need to turn off the human-made CO_2 emissions tap, or alternatively, any inflow coming from that tap needs to be matched by an equal outflow through the untested / uncertain drain

LATE, UNCOORDINATED ACTION | **DELAYED, DECISIVE ACTION** | **EARLY, EFFECTIVE ACTION**

THREE POSSIBLE WORLDS BEGIN TO DIVERGE IN THE 2020s...

Late, uncoordinated action:

- Warming steadily increases but the most extreme events affect less populated regions and do not raise global concern
- There are frequent heatwaves in several cities and less snow in mountain resorts in the Alps, Rockies and Andes

Delayed, decisive action:

- Internal natural climate variability leads to higher warming than projected. Temperatures regularly above 1.5°C warmer
- Public unrest increases due to deadly heatwaves in Chicago, Kolkata, Beijing, Karachi and Sao Paulo
- Emergency global summit in 2025 suddenly moves to much more ambitious climate targets

Early, effective action:

- Strong climate action in all major world regions at the national, state and city levels
- Transport is strongly decarbonized. More cars with electric than combustion engines sold by 2025
- Several industry-sized carbon capture and storage (CCS) plants installed and tested

All mitigation pathways projecting global warming of about 1.5°C include some probability of overshooting 1.5°C

There is still about a 50% probability that global warming will exceed 1.5°C even under pathways considered ‘1.5°C consistent’

If the world acts early on climate change, many of the irreversible risks to human societies and Earth’s ecosystems can be avoided

IN THE 2030s...

Late, uncoordinated action:

- Global warming of 1.5°C reached by 2030 but no major changes in policies occur
- Several catastrophic years follow an intense El Niño-La Niña phase in the 2030s
- Major heatwaves on all continents, with deadly consequences in tropical regions

Delayed, decisive action:

- Droughts in southern Europe, southern Africa and the Amazon, and flooding in Asia
- Costs are high to rapidly phase out fossil fuel infrastructure and upscale renewables owing to a global failure to support economic measures to drive the energy transition
- Disruptive technologies become crucial to adapt to a rapidly changing world

Early, effective action:

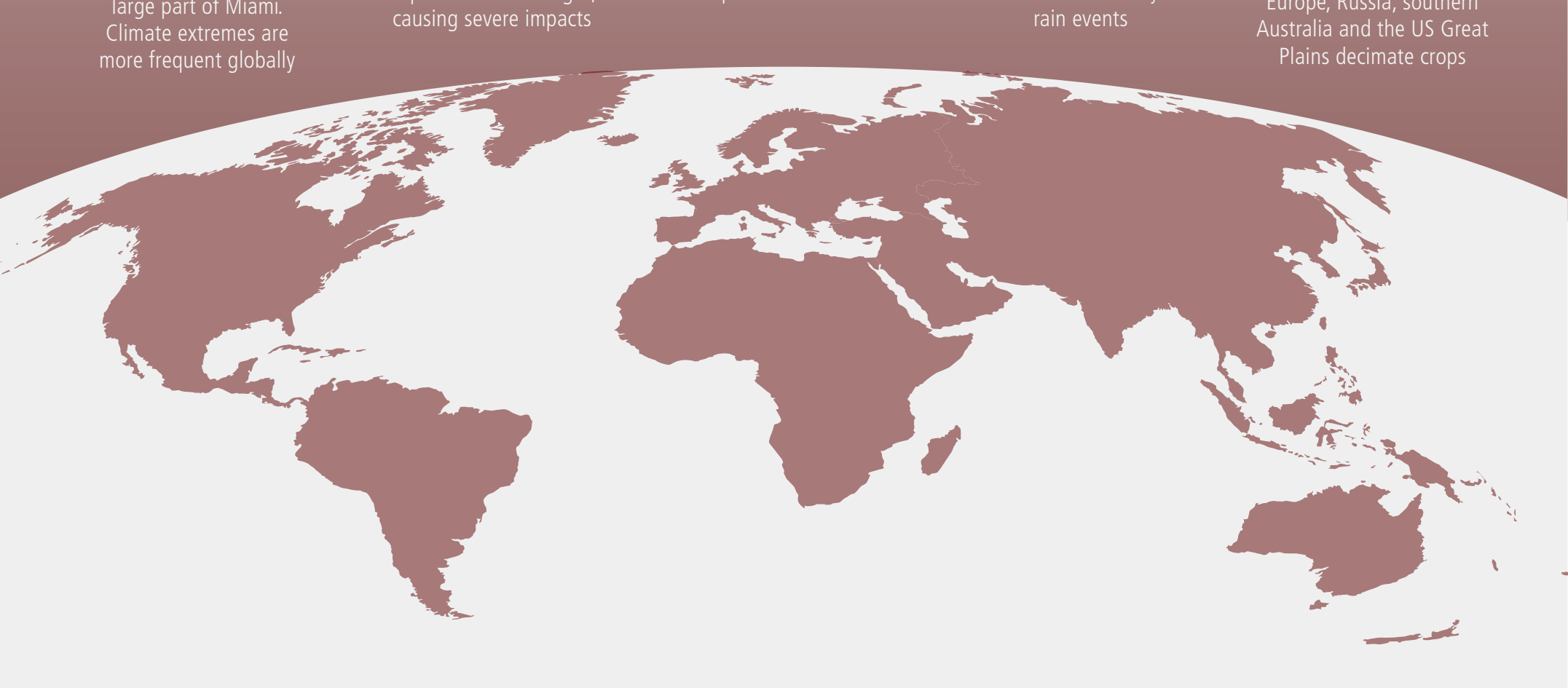
- The coordinated intensification of agriculture leaves many natural ecosystems relatively intact
- Food waste is slashed and a global move to healthy and more plant-based diets reduces GHG emissions from meat
- Bioenergy sourced from waste, algae and kelp farms helps minimise pressure on food production and biodiversity

FROM MID-CENTURY TO 2100: A CLOSER LOOK

LATE, UNCOORDINATED ACTION

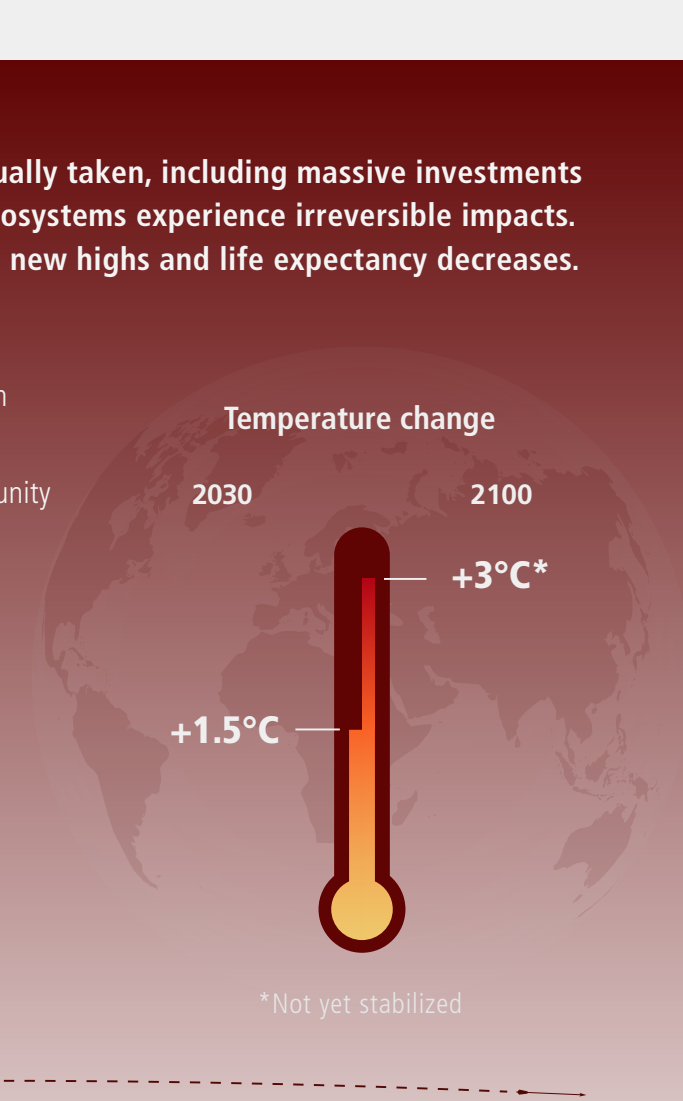
One possible storyline among worst-case scenarios

- **Storms:** A hurricane and high storm surges destroy a large part of Miami. Climate extremes are more frequent globally
- **Deforestation:** Deforestation continues in Amazon rainforest, which is also affected by an unprecedented drought, causing severe impacts
- **Ice sheet melt:** The retreat of the West Antarctic ice sheet accelerates, leading to more rapid sea level rise
- **Flooding:** Mid-latitude and tropical regions severely affected, in particular Asia, following increases in heavy rain events
- **Drought and crop failure:** Severe drought in the Mediterranean, eastern Europe, Russia, southern Australia and the US Great Plains decimate crops



Despite past pledges, global support for the Paris Agreement wanes. Major actions are eventually taken, including massive investments in renewable energy, but these efforts are uncoordinated and limited. Almost all of Earth’s ecosystems experience irreversible impacts. Progress on the Sustainable Development Goals (SDGs) is largely undone, poverty rates reach new highs and life expectancy decreases.

- Major increases in food prices and eroding food security increase the risk and incidence of starvation
- Several small island states give up hope of survival and look to increasingly fragmented global community for refuge. Life for many indigenous and rural groups become untenable in their ancestral lands
- High levels of public unrest and political destabilization due to increasing climatic pressures, resulting in some countries becoming dysfunctional
- Major conflicts take place, as well as extensive migration and forced displacement
- Solar Radiation Modification (SRM), a geoengineering solution, is proposed, but negotiations prove lengthy and inconclusive because of concerns about potential impacts on monsoon rainfall and risks in case of termination



*Not yet stabilized

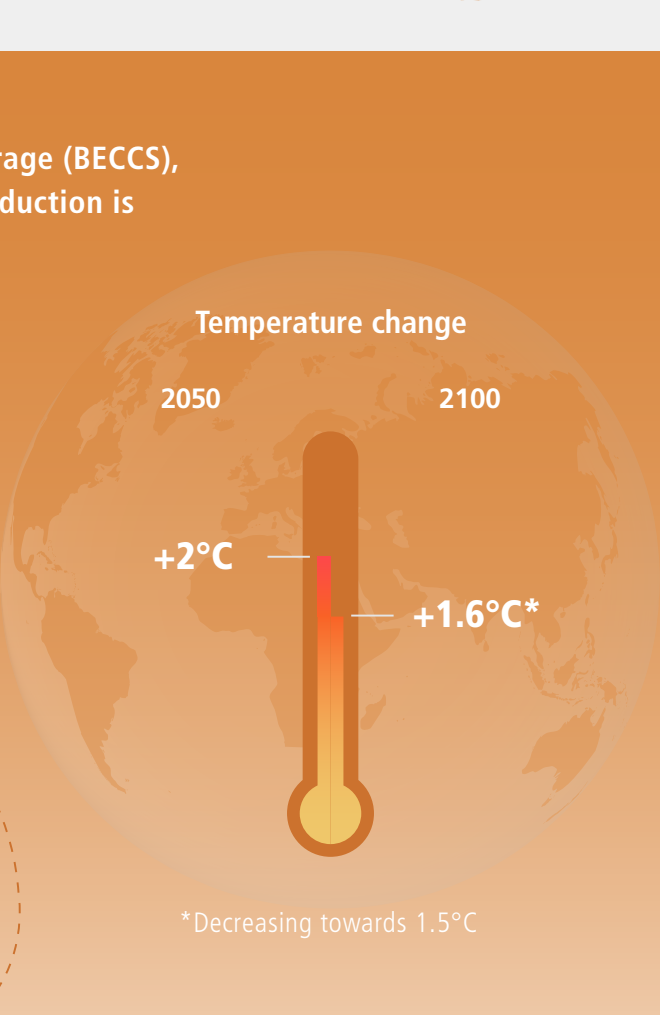
DELAYED, DECISIVE ACTION

One possible storyline among mid-case scenarios

- **Storms:** Intensifying storms and sea-level rise amplify risks on tropical and subtropical communities
- **Drought:** 2°C of warming for several decades eliminates or severely damages tropical forests
- **Crop failure:** Crop yields decline significantly in tropics, leading to prolonged famines in some African countries
- **Land-use change:** Many natural systems are lost, particularly in the Mediterranean and extinction rates increase greatly
- **Coral reef dieoff:** 2°C of warming for several decades eliminates coral reef and other marine ecosystems

Delayed action leads to the need to employ intensive Bioenergy with Carbon Capture and Storage (BECCS), but no effort is made to minimize the land and water footprint of BECCS production. Food production is prioritised over the protection of ecosystems, causing widespread problems.

- The intensive area required for the production of bioenergy, combined with increasing water stress, puts pressure on food prices, driving elevated rates of food insecurity, hunger and poverty
- Migration, forced displacement, and loss of identity is extensive in some countries, reversing some achievements in sustainable development and human security
- The ability to adapt to prevent the loss of ecosystems is hindered under the circumstances and is consequently minimal
- Reduced coastal defences from storms increase risks for tropical / subtropical coastal communities



*Decreasing towards 1.5°C

...followed by global efforts to reduce warming back to 1.5°C.

~0.5°C overshoot...

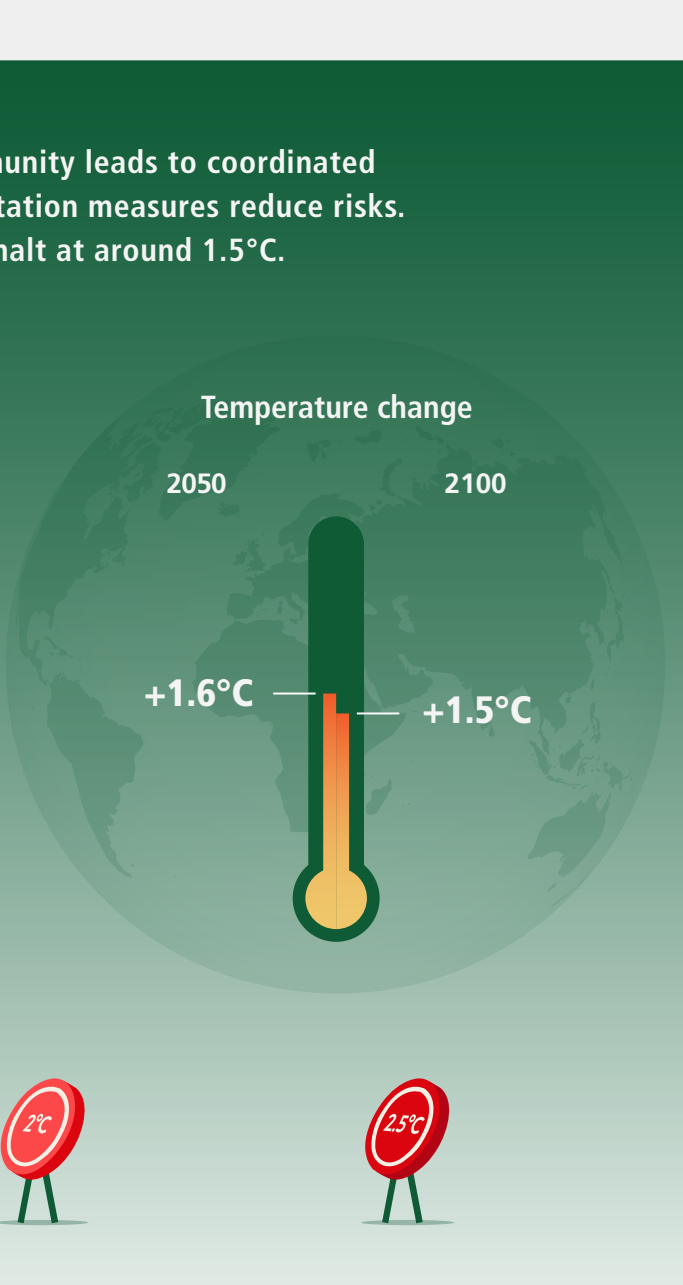
EARLY, EFFECTIVE ACTION

One possible storyline among best-case scenarios

- **Heatwaves:** Risks are reduced by proactive adaptation, but frequent heatwaves still affect the tropics, particularly in its megacities
- **Protection:** The Amazon is well preserved through reduced deforestation and avoided risk of droughts
- **Arctic melt:** Reduced Arctic sea ice opens new shipping lanes but devastates Arctic ecosystems
- **Dry spells:** The irrigation of crops expands, drawing the water table down in many areas such as the Mediterranean
- **Coral recovery:** Coral reefs partially recover by 2100 after extensive dieback

Strong adherence to the goals of the Paris Agreement by an almost unanimous global community leads to coordinated and rapid decarbonization. While some climate hazards become more frequent, timely adaptation measures reduce risks. Early global climate action, designed to minimize the land footprint, helps global warming halt at around 1.5°C.

- Coastal communities struggle with increased inundation associated with rising sea levels and more frequent and intense heavy rainfall, and some respond by moving
- Small island developing states (SIDS), coastal and low-lying areas face significant changes but largely persist in most regions
- In mid-latitudes, hot summers and precipitation events tend to be more intense and frequent
- Coordinated decarbonisation that takes a wider sustainability perspective minimizes the land footprint. Forest services have similar patterns as those observed at the beginning of the 21st Century. Crop yields remain stable
- Glaciers extent decreases in most mountainous areas leading to more long-term sea level rise



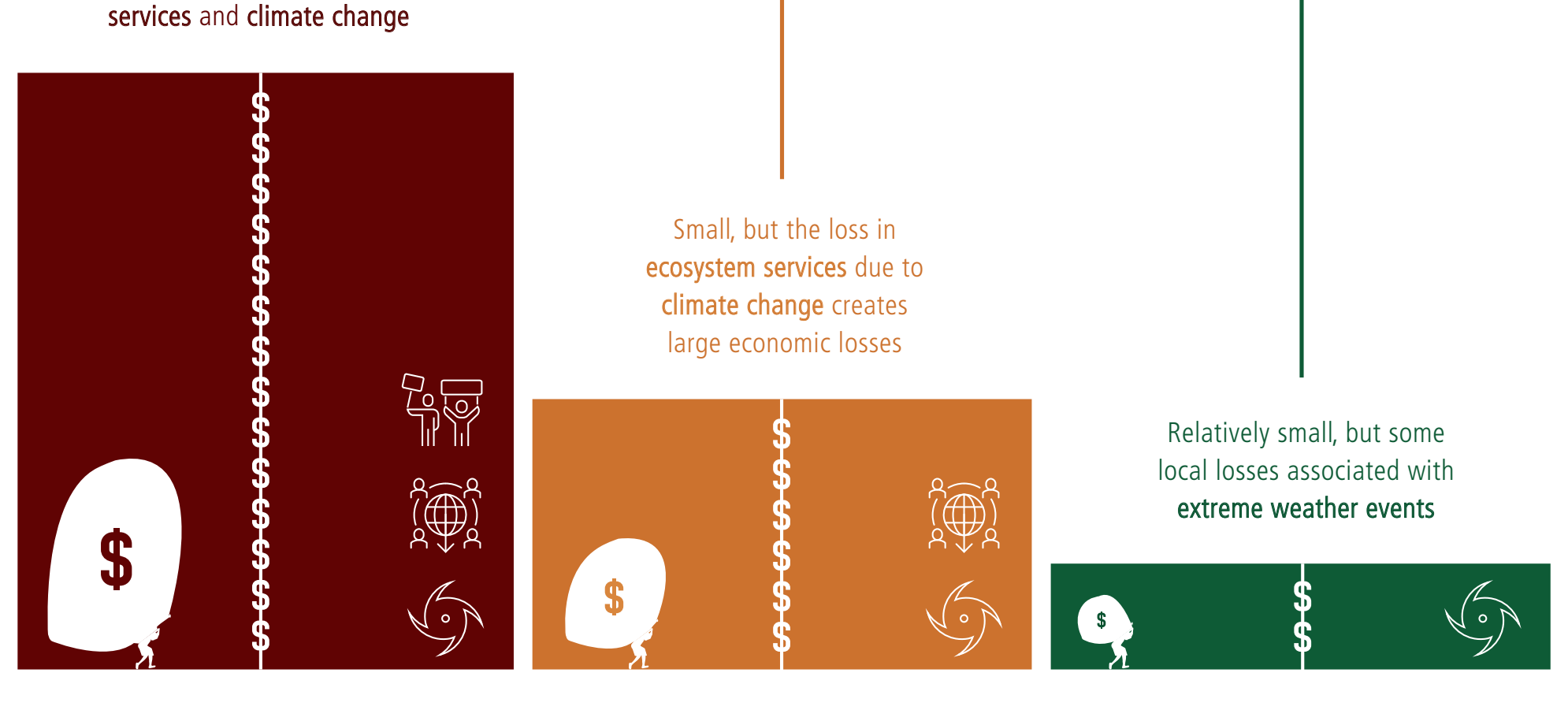
~0.1°C overshoot

AGGREGATE ECONOMIC DAMAGES BY 2100

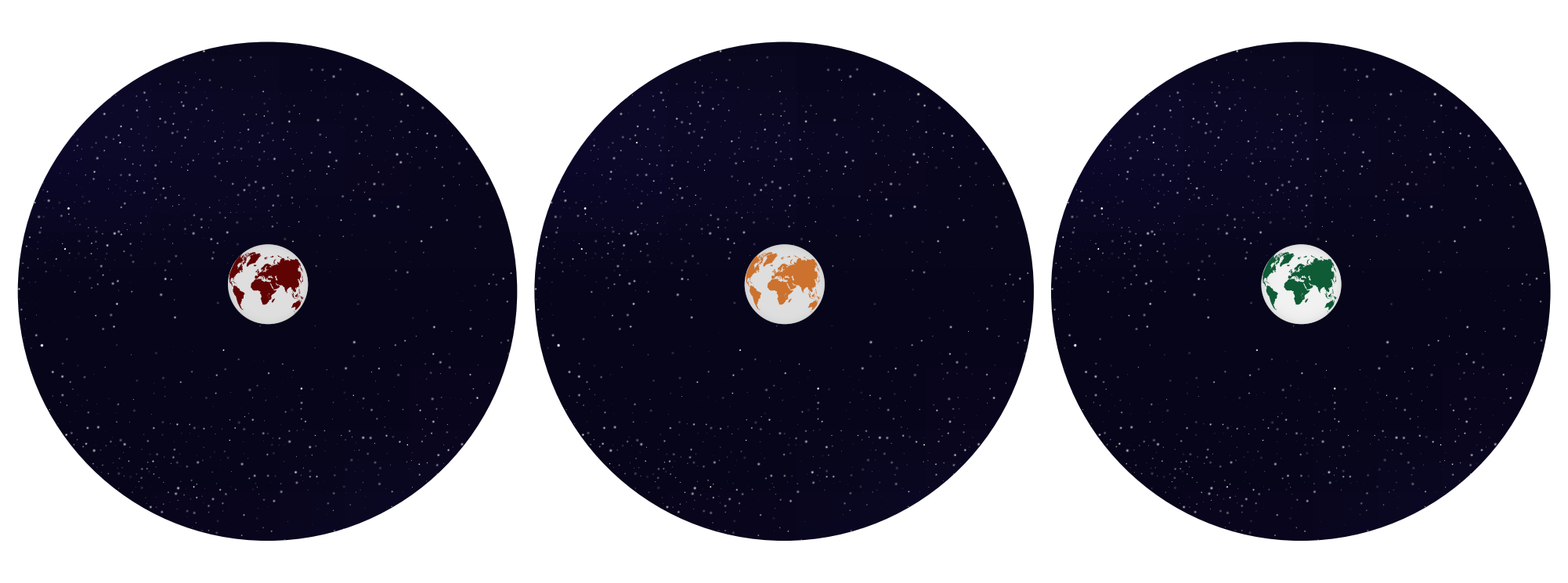
Substantial, owing to the combined effects of **political instability**, **losses of ecosystem services** and **climate change**

Small, but the loss in **ecosystem services** due to **climate change** creates large economic losses

Relatively small, but some local losses associated with **extreme weather events**



POSSIBLE WORLDS IN 2100 COMPARED WITH TODAY



No longer recognizable, with decreasing life expectancy, reduced outdoor labour productivity, and lower quality of life in many regions because of too frequent heatwaves and other climate extremes

The general health and well-being of people is substantially reduced compared to the conditions in 2020 and continues to worsen over the following decades

The health and well-being of people generally decrease from 2020, while the levels of poverty and disadvantage increase considerably

Thanks to risk management and adaptation, human well-being remains overall similar to that in 2020

The Earth system, while warmer, is still recognizable compared with the 2000s, and no major tipping points are reached

CHOOSING AN EARLY, EFFECTIVE ACTION WORLD IS NECESSARY, DESIRABLE AND ACHIEVABLE

EVERY ACTION MATTERS

EVERY BIT OF WARMING MATTERS

EVERY YEAR MATTERS

EVERY CHOICE MATTERS

BASED ON THREE STORYLINES OF POSSIBLE WORLDS RESULTING FROM DIFFERENT MITIGATION OPTIONS IN CROSS-CHAPTER BOX 8, TABLE 2, CHAPTER 3: IMPACTS OF 1.5°C OF GLOBAL WARMING ON NATURAL AND HUMAN SYSTEMS, SPECIAL REPORT ON GLOBAL WARMING OF 1.5°C, IPCC, 2018

CREATED BY JOHN LANG IN COLLABORATION WITH IPCC LEAD AUTHORS SONIA I. SENEVIRATNE AND JOERI ROGELJ