

# Considered at June 11, 2019 Regular Council Meeting

Council Agenda Information  
☒ Regular Council June 11, 2019

Item 9.3



## City of Port Moody Report/Recommendation to Council

Date: May 15, 2019

File No. 01-0530-01/2019

Submitted by: Councillor Amy Lubik and Acting Mayor Meghan Lahti

Subject: Climate Emergency Declaration

---

### Purpose / Introduction

To propose that Port Moody declare a Climate Emergency, implore higher levels of government to take action through UBCM and FCM motions, and to direct staff to 1) revise Port Moody's climate targets to reflect the IPCC 2018 report on what Port Moody's GHG emissions need to be to reach the City's Paris Accord targets, including interim targets, and 2) devise steps that need to be taken to meet those targets, including, but not limited to suggestions in this report and report back in 90 days.

---

### Recommended Resolutions

**THAT the City of Port Moody declare a climate emergency;**

**AND THAT the City of Port Moody update its GHG emission targets to be in line with the Intergovernmental Panel on Climate Change report targets, and include in its Climate Action Plan and other community plans new bold actions that the City could pursue to achieve its targets, including, but not limited to, the following six actions:**

1. aim to have 90% of all new residents live within an easy walk of their "daily needs";
2. accelerate its goal of having 40% of trips in the City made by walking, biking, or transit by 2030, and continue to champion regional transit initiatives;
3. have 50% of all cars driven on City roads be zero emissions vehicles by 2030;
4. aim to have all new and replacement heating and hot water systems in buildings produce zero emissions by 2025;
5. by 2030, reduce the carbon content of new buildings and construction projects by 40% (compared to 2018); and
6. include targets for enhancement, including opportunities for creek daylighting/enhancement, foreshore protection and enhancement, establishing connectivity between Environmentally Sensitive Areas (ESAs) and enhancing forest health in the City's ESA Management Strategy, and develop an urban forestry strategy that will move towards achieving the IPCC Goals;

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

## **Report/Recommendation to Council**

Climate Emergency Declaration

May 15, 2019

**AND THAT** letters be sent to the provincial and federal Finance Ministers imploring senior levels of government to take similar actions and make investments regarding the climate change crisis as they would in response to other crises, including, but not limited to: diverting subsidies from fossil fuel companies, or matching those investments to fund adaption for municipalities; the creation and expansion of carbon sequestration technology; the mandating of such technology for all polluters; just transition career training, particularly for low-income workers, those employed in fossil fuel dependent sectors, and Indigenous Communities [where desired by those communities]; rapid expansion of transit infrastructure, and clean energy retrofitting for all existing residential and institutional buildings, particularly for the most vulnerable in our society;

**AND THAT** the following resolution regarding Declaration of a Climate Emergency be endorsed and forwarded for consideration at the 2019 UBCM convention and next possible FCM convention:

**WHEREAS** in 2018, the Intergovernmental Panel on Climate Change (IPCC) released a Special Report stating that emissions must decline by 45% from 2010 levels by 2030 and reach net zero by 2050 in order to avoid severe climate change impacts;

**AND WHEREAS** the World Health Organization has declared climate change to be the number one health emergency of our time;

**AND WHEREAS** local governments and cities are globally taking the lead on climate action, with more than 90 cities in the USA committing to 100% renewable energy by 2050, 15 cities in Canada committing to 100% renewable energy by 2050, and 20 cities committing to 80-100% GHG emissions reduction by 2050, and are calling on senior levels of government for a more urgent, emergency response;

**THEREFORE BE IT RESOLVED THAT** the Province of British Columbia [and Canadian Federal Government] take similar actions and make similar investments regarding the climate change crisis as they would in response to other crises, including, but not limited to: diverting subsidies from fossil fuel companies, or matching those investments to fund adaption for municipalities; the creation and expansion of carbon sequestration technology; the mandating of such technology for all polluters; just transition career training, particularly for low-income workers, those employed in fossil fuel dependent sectors, and Indigenous Communities [where desired by those communities]; rapid expansion of transit infrastructure; and clean energy retrofitting for all existing residential and institutional building, particularly for the most vulnerable in our society.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

## **Report/Recommendation to Council**

Climate Emergency Declaration

May 15, 2019

### **Background**

In 2018, the Intergovernmental Panel on Climate Change (IPCC) released a Special Report stating that emissions must decline by 45% from 2010 levels by 2030 and reach net zero by 2050 in order to avoid severe climate change impacts (**Attachment 1**). Port Moody should be striving to meet these targets, as should all municipalities, provinces, countries, and corporations.

Port Moody Council has declared its dedication to fighting climate change and being a leader in mitigation, adaptation, and resilience, and we are currently formulating a plan to combat climate change for our city. What we do matters. As a small municipality on the frontlines of sea-level rise and wildfire interfaces, we can set a precedent and be an example for communities all over the world. It is imperative that we declare climate change the emergency it is and push other levels of government to take significant action, as we, as a municipality, cannot do this alone. We also know that those most impacted by climate change will be the most impoverished in our society and that we need a just transition for workers away from precarious and now more frequently automated fossil fuel dependent work into equally well-paying, more stable jobs, as no one should be forced into poverty due to trying to create a better world (**Attachment 2**); this should be a great opportunity to increase equity in our country and the world, as much as it is a crisis. Emergencies require restricting and reprioritizing of resources and we need to do just that. Currently, municipalities can barely keep up with maintenance of our aging infrastructure, let alone building up for climate change resilience; funds need to be diverted to this cause and it makes the most sense to funding it at least to the capacity to which we are currently subsidizing fossil fuel companies.

### **Discussion**

Other cities that have declared a climate change emergency have made the following directives:

- 1) pass a formal resolution to adopt the latest IPCC recommended GHG reduction targets of 45% below 2010 levels by 2030, 65% by 2040, and 100% by 2050 for all community-wide emissions;
- 2) establish a meaningful set of interim targets and ensure that these targets are incorporated into all relevant municipal planning documents (OCPs, CEEPs, etc.) that the city creates from this point forward; and
- 3) direct city staff to draft a plan for annual transparent measuring and reporting on the municipality's community emissions beginning no later than 2020, including a proposal for how these activities will be funded.

Vancouver's staff recommended six bold actions to tackle climate change and these should be considered for Port Moody, with the staff climate action working group directed to suggest their own versions, additions, and recommendations for Port Moody, in order to meet our targets.

These actions include:

- aim to have 90% of all new residents live within an easy walk of their "daily needs"; and
- accelerate its goal of having two-third of trips in the city by walking, biking, or transit by 2030 (instead of 2040).

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

## **Report/Recommendation to Council**

Climate Emergency Declaration

May 15, 2019

The current Port Moody MTP target is for a 40% sustainable mode share by 2040. Staff currently estimate we are at a sustainable mode share of about 20%. The City's target also took into account sustainable mode share for our entire region that currently sits at 27% according to the most recent (2011) information from TransLink. Our target was also developed with input from TransLink and how we can help achieve the regional Metro Vancouver sustainable mode share target of 50% by 2045 (per the Regional Transportation Strategy).

Given that Port Moody is starting from a much lower baseline than Vancouver, the exact same targets may not be reachable; however, staff could be directed to include more aggressive targets as new TransLink developments occur, and prioritize the creation of more local jobs, in order to decrease commuting.

Further, Port Moody Council should taking a strong proactive stance on regional initiatives such as congestion pricing [with equity considerations], which could also help expedite reaching our target.

- have 50% of all cars driven on city roads be zero emissions vehicles by 2030;
- aim to have all new and replacement heating and hot water systems in buildings produce zero emissions by 2025;
- reduce the carbon content of new buildings and construction projects by 40% (compared to 2018) by 2030 by shifting from concrete to wooden constructions and shifting to lower-emission concrete; and
- by 2030, restore enough forest and coastal ecosystems in the city to remove one million tonnes of carbon pollution every year by 2060.

Port Moody should consider a similar realistic but lofty goal, including retention and expansion of our tree canopy, ecosystem restoration and enhancement, and creek daylighting/ restoration. The City's Environmentally Sensitive Areas (ESA) Management Strategy update will include the percentage canopy cover and other metrics/performance indicators related to hectares of natural area protected, unprotected, areas restored, etc. The intent of the ESA Management Strategy update is to provide direction on areas within ESAs that are suitable for enhancement, including opportunities for creek daylighting/enhancement, foreshore protection and enhancement, establishing connectivity between ESAs, and enhancing forest health. In addition, the update will include improvements to the development permit process to ensure successful implementation of the principles that underlay the ESA Management Strategy.

Goals and metrics such as tonnes of carbon sequestration/carbon storage, tonnes of pollution removed, and cubic meters of avoided stormwater runoff are common measures included in Urban Forest Strategies. Staff should be directed to create an Urban Forest Strategy.

The Intergovernmental Panel on Climate Change has stated that we only have 11 years left to turn this situation around. Port Moody is already a leader in climate action; it is time to make sure we are meeting our targets to ensure future generations have hope and a just and sustainable future.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

## **Report/Recommendation to Council**

Climate Emergency Declaration

May 15, 2019

### Other Options

THAT the report dated May 15, 2019 from Councillor Amy Lubik and Acting Mayor Meghan Lahti regarding Climate Emergency Declaration be received for information.

### Financial Implications

Staff would need to report back on financial implications depending on actions taken. Where possible, funds should be diverted from the gas tax and grants should be applied for.

### Communications / Civic Engagement

There are no communications or civic engagement initiatives required by the recommendations in this report.

### Council Strategic Plan Objectives

Climate Change Reliance and Leadership are central to Council's Strategic Plan.

### Attachments:

1. Intergovernmental Panel on Climate Change 2018 Global Warming of 1.5° C Report.
2. Climate Justice Alliance – Just Transition Principles.

# Considered at June 11, 2019 Regular Council Meeting



RC - Agenda - 2019 06 11

Item 9.3

## **Report/Recommendation to Council**

Climate Emergency Declaration

May 15, 2019

Prepared by:	
	
<hr/>	<hr/>
Amy Lubik Councillor	Meghan Lahti Acting Mayor

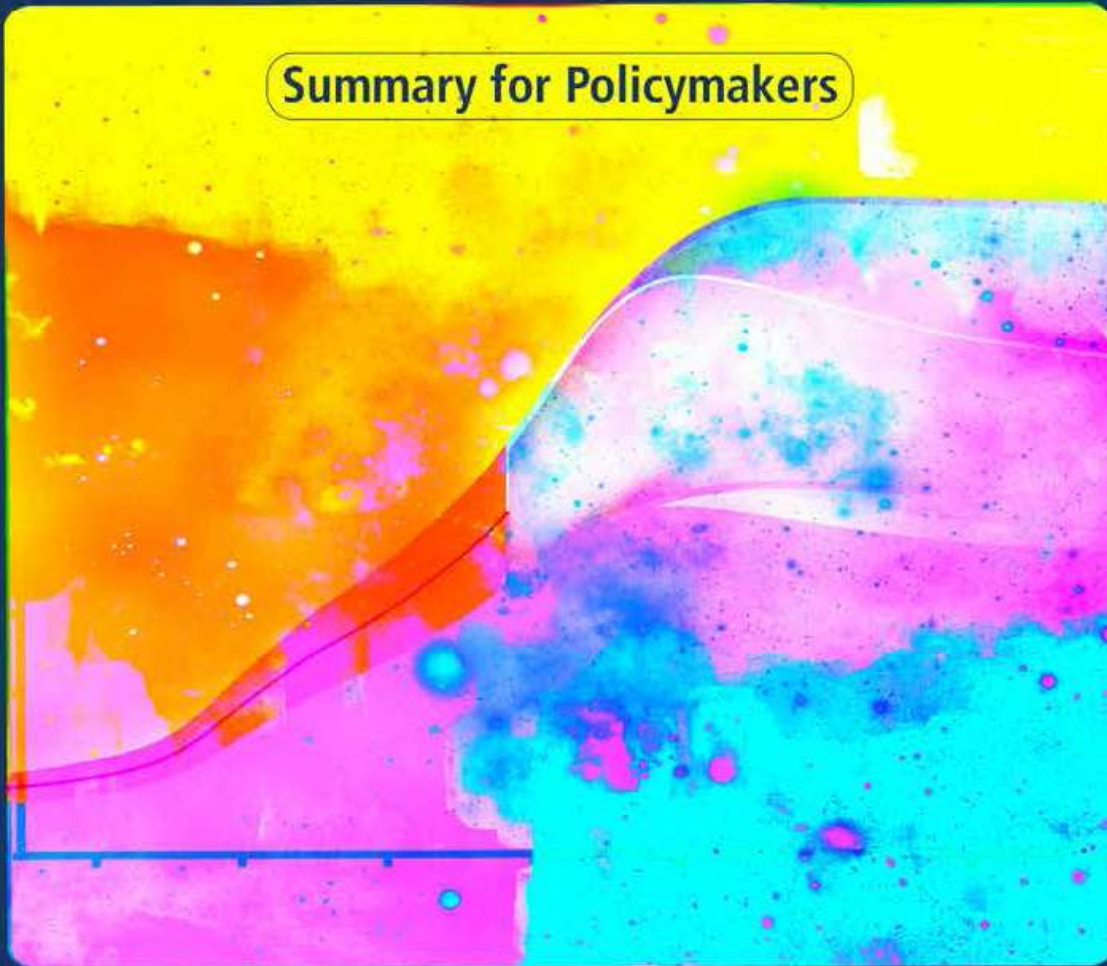
ipcc

INTERGOVERNMENTAL PANEL ON climate change

# Global Warming of 1.5°C

An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty

Summary for Policymakers



WG I

WG II

WG III



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

## Global warming of 1.5°C

**An IPCC Special Report on the impacts of global warming of 1.5°C  
above pre-industrial levels and related global greenhouse gas emission pathways,  
in the context of strengthening the global response to the threat of climate change,  
sustainable development, and efforts to eradicate poverty**

### Summary for Policymakers

#### Edited by

**Valérie Masson-Delmotte**  
Co-Chair Working Group I

**Hans-Otto Pörtner**  
Co-Chair Working Group II

**Jim Skea**  
Co-Chair Working Group III

**Panmao Zhai**  
Co-Chair Working Group I

**Debra Roberts**  
Co-Chair Working Group II

**Priyadarshi R. Shukla**  
Co-Chair Working Group III

**Anna Pirani**  
Head of WGI TSU

**Roz Pidcock**  
Head of Communication

**Yang Chen**  
Science Officer

**Elisabeth Lonnoy**  
Project Assistant

**Wilfran Moufouma-Okia**  
Head of Science

**Sarah Connors**  
Science Officer

**Xiao Zhou**  
Science Assistant

**Tom Maycock**  
Science Editor

**Clotilde Péan**  
Head of Operations

**J. B. Robin Matthews**  
Science Officer

**Melissa I. Gomis**  
Graphics Officer

**Melinda Tignor**  
Head of WGII TSU

**Tim Waterfield**  
IT Officer

**Working Group I Technical Support Unit**



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

## Summary for Policymakers

# SPM

## Summary for Policymakers

### Drafting Authors:

Myles Allen (UK), Mustafa Babiker (Sudan), Yang Chen (China), Heleen de Coninck (Netherlands/EU), Sarah Connors (UK), Renée van Diemen (Netherlands), Opha Pauline Dube (Botswana), Kristie L. Ebi (USA), Francois Engelbrecht (South Africa), Marion Ferrat (UK/France), James Ford (UK/Canada), Piers Forster (UK), Sabine Fuss (Germany), Tania Guillén Bolaños (Germany/Nicaragua), Jordan Harold (UK), Ove Hoegh-Guldberg (Australia), Jean-Charles Hourcade (France), Daniel Huppmann (Austria), Daniela Jacob (Germany), Kejun Jiang (China), Tom Gabriel Johansen (Norway), Mikiko Kainuma (Japan), Kiane de Kleijne (Netherlands/EU), Elmar Kriegler (Germany), Debora Ley (Guatemala/Mexico), Diana Liverman (USA), Natalie Mahowald (USA), Valérie Masson-Delmotte (France), J. B. Robin Matthews (UK), Richard Millar (UK), Katja Mintenbeck (Germany), Angela Morelli (Norway/Italy), Wilfran Moufouma-Okia (France/Congo), Luis Mundaca (Sweden/Chile), Maike Nicolai (Germany), Chukwumerije Okereke (UK/Nigeria), Minal Pathak (India), Anthony Payne (UK), Roz Pidcock (UK), Anna Pirani (Italy), Elvira Poloczanska (UK/Australia), Hans-Otto Pörtner (Germany), Aromar Revi (India), Keywan Riahi (Austria), Debra C. Roberts (South Africa), Joeri Rogelj (Austria/Belgium), Joyashree Roy (India), Sonia I. Seneviratne (Switzerland), Priyadarshi R. Shukla (India), James Skea (UK), Raphael Slade (UK), Drew Shindell (USA), Chandni Singh (India), William Solecki (USA), Linda Steg (Netherlands), Michael Taylor (Jamaica), Petra Tschakert (Australia/Austria), Henri Waisman (France), Rachel Warren (UK), Panmao Zhai (China), Kirsten Zickfeld (Canada).

### This Summary for Policymakers should be cited as:

IPCC, 2018: Summary for Policymakers. In: *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P. R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. *World Meteorological Organization, Geneva, Switzerland, 32 pp.*

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

## Acknowledgements

We are very grateful for the expertise, rigour and dedication shown throughout by the volunteer Coordinating Lead Authors and Lead Authors, working across scientific disciplines in each chapter of the report, with essential help by the many Contributing Authors. The Review Editors have played a critical role in assisting the author teams and ensuring the integrity of the review process. We express our sincere appreciation to all the expert and government reviewers. A special thanks goes to the Chapter Scientists of this report who went above and beyond what was expected of them: Neville Ellis, Tania Guillén Bolaños, Daniel Huppmann, Kiane de Kleijne, Richard Millar and Chandni Singh.

We would also like to thank the three Intergovernmental Panel on Climate Change (IPCC) Vice-Chairs Ko Barrett, Thelma Krug, and Youba Sokona as well as the members of the WGI, WGII and WGIII Bureaux for their assistance, guidance, and wisdom throughout the preparation of the Report: Amjad Abdulla, Edvin Aldrian, Carlo Carraro, Diriba Korecha Dadi, Fatima Driouech, Andreas Fischlin, Gregory Flato, Jan Fuglestedt, Mark Howden, Nagmeldin G. E. Mahmoud, Carlos Mendez, Joy Jacqueline Pereira, Ramón Pichs-Madruga, Andy Reisinger, Roberto Sánchez Rodríguez, Sergey Semenov, Muhammad I. Tariq, Diana Ürgel-Vorsatz, Carolina Vera, Pius Yanda, Nouredine Yassaa, and Taha Zatari.

Our heartfelt thanks go to the hosts and organizers of the scoping meeting and the four Special Report on 1.5°C Lead Author Meetings. We gratefully acknowledge the support from the host countries and institutions: World Meteorological Organization, Switzerland; Ministry of Foreign Affairs, and the National Institute for Space Research (INPE), Brazil; Met Office and the University of Exeter, the United Kingdom; Swedish Meteorological and Hydrological Institute (SMHI), Sweden; the Ministry of Environment Natural Resources Conservation and Tourism, the National Climate Change Committee in the Department of Meteorological Services and the Botswana Global Environmental Change Committee at the University of Botswana, Botswana; and the government of the Republic of Korea. The support provided by governments and institutions, as well as through contributions to the IPCC Trust Fund, is thankfully acknowledged as it enabled the participation of the author teams in the preparation of the Report. The efficient operation of the Working Group I Technical Support Unit was made possible by the generous financial support provided by the government of France and administrative and information technology support from the Université Paris Saclay (France), Institut Pierre Simon Laplace (IPSL) and the Laboratoire des Sciences du Climat et de l'Environnement (LSCE). We thank the Norwegian Environment Agency for supporting the preparation of the graphics for the Summary for Policymakers. We thank the UNEP Library, who supported authors throughout the drafting process by providing literature for the assessment.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

We would also like to thank Abdalah Mokssit, Secretary of the IPCC, and the staff of the IPCC Secretariat: Kerstin Stendahl, Jonathan Lynn, Sophie Schlingemann, Judith Ewa, Mxolisi Shongwe, Jesbin Baidya, Werani Zabula, Nina Peeva, Joelle Fernandez, Annie Courtin, Laura Biagioni and Oksana Ekzarho. Thanks are due to Elhousseine Gouaini who served as the conference officer for the 48th Session of the IPCC.

Finally, our particular appreciation goes to the Working Group Technical Support Units whose tireless dedication, professionalism and enthusiasm led the production of this Special Report. This report could not have been prepared without the commitment of members of the Working Group I Technical Support Unit, all new to the IPCC, who rose to the unprecedented Sixth Assessment Report challenge and were pivotal in all aspects of the preparation of the Report: Yang Chen, Sarah Connors, Melissa Gomis, Elisabeth Lonnoy, Robin Matthews, Wilfran Moufouma-Okia, Clotilde Péan, Roz Pidcock, Anna Pirani, Nicholas Reay, Tim Waterfield, and Xiao Zhou. Our warmest thanks go to the collegial and collaborative support provided by Marlies Craig, Andrew Okem, Jan Petzold, Melinda Tignor and Nora Weyer from the WGII Technical Support Unit and Bhushan Kankal, Suvadip Neogi and Joana Portugal Pereira from the WGIII Technical Support Unit. A special thanks goes to Kenny Coventry, Harmen Gudde, Irene Lorenzoni, and Stuart Jenkins for their support with the figures in the Summary for Policymakers, as well as Nigel Hawtin for graphical support of the Report. In addition, the following contributions are gratefully acknowledged: Jatinder Padda (copy edit), Melissa Dawes (copy edit), Marilyn Anderson (index), Vincent Grégoire (layout) and Sarah le Rouzic (intern).

The Special Report website has been developed by Habitat 7, led by Jamie Herring, and the report content has been prepared and managed for the website by Nicholas Reay and Tim Waterfield. We gratefully acknowledge the UN Foundation for supporting the website development.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

## Summary for Policymakers

SPM

## Introduction

This Report responds to the invitation for IPCC ‘... to provide a Special Report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways’ contained in the Decision of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the Paris Agreement.<sup>1</sup>

The IPCC accepted the invitation in April 2016, deciding to prepare this Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

This Summary for Policymakers (SPM) presents the key findings of the Special Report, based on the assessment of the available scientific, technical and socio-economic literature<sup>2</sup> relevant to global warming of 1.5°C and for the comparison between global warming of 1.5°C and 2°C above pre-industrial levels. The level of confidence associated with each key finding is reported using the IPCC calibrated language.<sup>3</sup> The underlying scientific basis of each key finding is indicated by references provided to chapter elements. In the SPM, knowledge gaps are identified associated with the underlying chapters of the Report.

## A. Understanding Global Warming of 1.5°C<sup>4</sup>

**A.1 Human activities are estimated to have caused approximately 1.0°C of global warming<sup>5</sup> above pre-industrial levels, with a *likely* range of 0.8°C to 1.2°C. Global warming is *likely* to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (*high confidence*) (Figure SPM.1) {1.2}**

A.1.1 Reflecting the long-term warming trend since pre-industrial times, observed global mean surface temperature (GMST) for the decade 2006–2015 was 0.87°C (*likely* between 0.75°C and 0.99°C)<sup>6</sup> higher than the average over the 1850–1900 period (*very high confidence*). Estimated anthropogenic global warming matches the level of observed warming to within ±20% (*likely range*). Estimated anthropogenic global warming is currently increasing at 0.2°C (*likely* between 0.1°C and 0.3°C) per decade due to past and ongoing emissions (*high confidence*). {1.2.1, Table 1.1, 1.2.4}

A.1.2 Warming greater than the global annual average is being experienced in many land regions and seasons, including two to three times higher in the Arctic. Warming is generally higher over land than over the ocean. (*high confidence*) {1.2.1, 1.2.2, Figure 1.1, Figure 1.3, 3.3.1, 3.3.2}

A.1.3 Trends in intensity and frequency of some climate and weather extremes have been detected over time spans during which about 0.5°C of global warming occurred (*medium confidence*). This assessment is based on several lines of evidence, including attribution studies for changes in extremes since 1950. {3.3.1, 3.3.2, 3.3.3}

1 Decision 1/CP.21, paragraph 21.

2 The assessment covers literature accepted for publication by 15 May 2018.

3 Each finding is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, *medium confidence*. The following terms have been used to indicate the assessed likelihood of an outcome or a result: virtually certain 99–100% probability, very likely 90–100%, likely 66–100%, about as likely as not 33–66%, unlikely 0–33%, very unlikely 0–10%, exceptionally unlikely 0–1%. Additional terms (extremely likely 95–100%, more likely than not >50–100%, more unlikely than likely 0–<50%, extremely unlikely 0–5%) may also be used when appropriate. Assessed likelihood is typeset in italics, for example, *very likely*. This is consistent with AR5.

4 See also Box SPM.1: Core Concepts Central to this Special Report.

5 Present level of global warming is defined as the average of a 30-year period centred on 2017 assuming the recent rate of warming continues.

6 This range spans the four available peer-reviewed estimates of the observed GMST change and also accounts for additional uncertainty due to possible short-term natural variability. {1.2.1, Table 1.1}

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

- A.2 Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (*high confidence*), but these emissions alone are *unlikely* to cause global warming of 1.5°C (*medium confidence*). (Figure SPM.1) {1.2, 3.3, Figure 1.5}**
- A.2.1 Anthropogenic emissions (including greenhouse gases, aerosols and their precursors) up to the present are *unlikely* to cause further warming of more than 0.5°C over the next two to three decades (*high confidence*) or on a century time scale (*medium confidence*). {1.2.4, Figure 1.5}
- A.2.2 Reaching and sustaining net zero global anthropogenic CO<sub>2</sub> emissions and declining net non-CO<sub>2</sub> radiative forcing would halt anthropogenic global warming on multi-decadal time scales (*high confidence*). The maximum temperature reached is then determined by cumulative net global anthropogenic CO<sub>2</sub> emissions up to the time of net zero CO<sub>2</sub> emissions (*high confidence*) and the level of non-CO<sub>2</sub> radiative forcing in the decades prior to the time that maximum temperatures are reached (*medium confidence*). On longer time scales, sustained net negative global anthropogenic CO<sub>2</sub> emissions and/or further reductions in non-CO<sub>2</sub> radiative forcing may still be required to prevent further warming due to Earth system feedbacks and to reverse ocean acidification (*medium confidence*) and will be required to minimize sea level rise (*high confidence*). {Cross-Chapter Box 2 in Chapter 1, 1.2.3, 1.2.4, Figure 1.4, 2.2.1, 2.2.2, 3.4.4.8, 3.4.5.1, 3.6.3.2}
- A.3 Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C (*high confidence*). These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options (*high confidence*). (Figure SPM.2) {1.3, 3.3, 3.4, 5.6}**
- A.3.1 Impacts on natural and human systems from global warming have already been observed (*high confidence*). Many land and ocean ecosystems and some of the services they provide have already changed due to global warming (*high confidence*). (Figure SPM.2) {1.4, 3.4, 3.5}
- A.3.2 Future climate-related risks depend on the rate, peak and duration of warming. In the aggregate, they are larger if global warming exceeds 1.5°C before returning to that level by 2100 than if global warming gradually stabilizes at 1.5°C, especially if the peak temperature is high (e.g., about 2°C) (*high confidence*). Some impacts may be long-lasting or irreversible, such as the loss of some ecosystems (*high confidence*). {3.2, 3.4.4, 3.6.3, Cross-Chapter Box 8 in Chapter 3}
- A.3.3 Adaptation and mitigation are already occurring (*high confidence*). Future climate-related risks would be reduced by the upscaling and acceleration of far-reaching, multilevel and cross-sectoral climate mitigation and by both incremental and transformational adaptation (*high confidence*). {1.2, 1.3, Table 3.5, 4.2.2, Cross-Chapter Box 9 in Chapter 4, Box 4.2, Box 4.3, Box 4.6, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.4.1, 4.4.4, 4.4.5, 4.5.3}

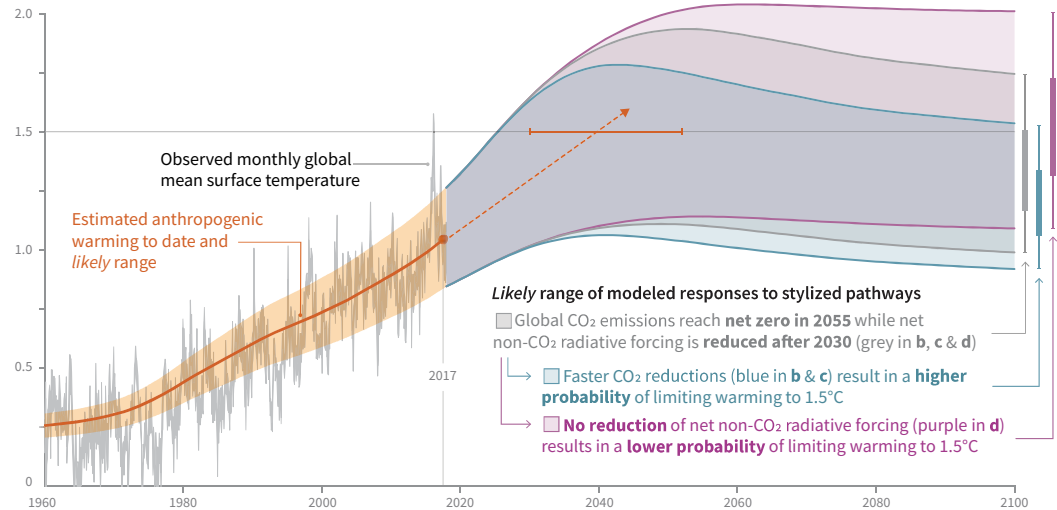
Summary for Policymakers

SPM

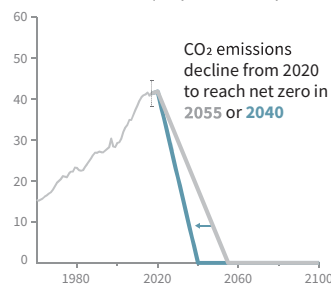
## Cumulative emissions of CO<sub>2</sub> and future non-CO<sub>2</sub> radiative forcing determine the probability of limiting warming to 1.5°C

### a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways

Global warming relative to 1850-1900 (°C)

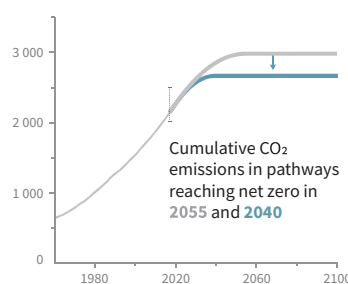


### b) Stylized net global CO<sub>2</sub> emission pathways Billion tonnes CO<sub>2</sub> per year (GtCO<sub>2</sub>/yr)



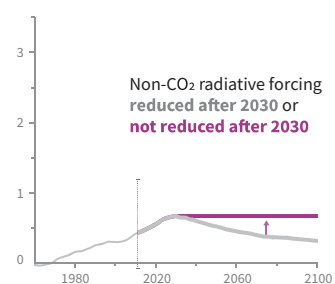
Faster immediate CO<sub>2</sub> emission reductions limit cumulative CO<sub>2</sub> emissions shown in panel (c).

### c) Cumulative net CO<sub>2</sub> emissions Billion tonnes CO<sub>2</sub> (GtCO<sub>2</sub>)



Maximum temperature rise is determined by cumulative net CO<sub>2</sub> emissions and net non-CO<sub>2</sub> radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

### d) Non-CO<sub>2</sub> radiative forcing pathways Watts per square metre (W/m<sup>2</sup>)



**Figure SPM.1** | Panel a: Observed monthly global mean surface temperature (GMST, grey line up to 2017, from the HadCRUT4, GISTEMP, Cowtan–Way, and NOAA datasets) change and estimated anthropogenic global warming (solid orange line up to 2017, with orange shading indicating assessed *likely* range). Orange dashed arrow and horizontal orange error bar show respectively the central estimate and *likely* range of the time at which 1.5°C is reached if the current rate of warming continues. The grey plume on the right of panel a shows the *likely* range of warming responses, computed with a simple climate model, to a stylized pathway (hypothetical future) in which net CO<sub>2</sub> emissions (grey line in panels b and c) decline in a straight line from 2020 to reach net zero in 2055 and net non-CO<sub>2</sub> radiative forcing (grey line in panel d) increases to 2030 and then declines. The blue plume in panel a shows the response to faster CO<sub>2</sub> emissions reductions (blue line in panel b), reaching net zero in 2040, reducing cumulative CO<sub>2</sub> emissions (panel c). The purple plume shows the response to net CO<sub>2</sub> emissions declining to zero in 2055, with net non-CO<sub>2</sub> forcing remaining constant after 2030. The vertical error bars on right of panel a show the *likely* ranges (thin lines) and central terciles (33rd – 66th percentiles, thick lines) of the estimated distribution of warming in 2100 under these three stylized pathways. Vertical dotted error bars in panels b, c and d show the *likely* range of historical annual and cumulative global net CO<sub>2</sub> emissions in 2017 (data from the Global Carbon Project) and of net non-CO<sub>2</sub> radiative forcing in 2011 from AR5, respectively. Vertical axes in panels c and d are scaled to represent approximately equal effects on GMST. [1.2.1, 1.2.3, 1.2.4, 2.3, Figure 1.2 and Chapter 1 Supplementary Material, Cross-Chapter Box 2 in Chapter 1]

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

## B. Projected Climate Change, Potential Impacts and Associated Risks

**B.1 Climate models project robust<sup>7</sup> differences in regional climate characteristics between present-day and global warming of 1.5°C,<sup>8</sup> and between 1.5°C and 2°C.<sup>8</sup> These differences include increases in: mean temperature in most land and ocean regions (*high confidence*), hot extremes in most inhabited regions (*high confidence*), heavy precipitation in several regions (*medium confidence*), and the probability of drought and precipitation deficits in some regions (*medium confidence*). {3.3}**

B.1.1 Evidence from attributed changes in some climate and weather extremes for a global warming of about 0.5°C supports the assessment that an additional 0.5°C of warming compared to present is associated with further detectable changes in these extremes (*medium confidence*). Several regional changes in climate are assessed to occur with global warming up to 1.5°C compared to pre-industrial levels, including warming of extreme temperatures in many regions (*high confidence*), increases in frequency, intensity, and/or amount of heavy precipitation in several regions (*high confidence*), and an increase in intensity or frequency of droughts in some regions (*medium confidence*). {3.2, 3.3.1, 3.3.2, 3.3.3, 3.3.4, Table 3.2}

B.1.2 Temperature extremes on land are projected to warm more than GMST (*high confidence*): extreme hot days in mid-latitudes warm by up to about 3°C at global warming of 1.5°C and about 4°C at 2°C, and extreme cold nights in high latitudes warm by up to about 4.5°C at 1.5°C and about 6°C at 2°C (*high confidence*). The number of hot days is projected to increase in most land regions, with highest increases in the tropics (*high confidence*). {3.3.1, 3.3.2, Cross-Chapter Box 8 in Chapter 3}

B.1.3 Risks from droughts and precipitation deficits are projected to be higher at 2°C compared to 1.5°C of global warming in some regions (*medium confidence*). Risks from heavy precipitation events are projected to be higher at 2°C compared to 1.5°C of global warming in several northern hemisphere high-latitude and/or high-elevation regions, eastern Asia and eastern North America (*medium confidence*). Heavy precipitation associated with tropical cyclones is projected to be higher at 2°C compared to 1.5°C global warming (*medium confidence*). There is generally *low confidence* in projected changes in heavy precipitation at 2°C compared to 1.5°C in other regions. Heavy precipitation when aggregated at global scale is projected to be higher at 2°C than at 1.5°C of global warming (*medium confidence*). As a consequence of heavy precipitation, the fraction of the global land area affected by flood hazards is projected to be larger at 2°C compared to 1.5°C of global warming (*medium confidence*). {3.3.1, 3.3.3, 3.3.4, 3.3.5, 3.3.6}

**B.2 By 2100, global mean sea level rise is projected to be around 0.1 metre lower with global warming of 1.5°C compared to 2°C (*medium confidence*). Sea level will continue to rise well beyond 2100 (*high confidence*), and the magnitude and rate of this rise depend on future emission pathways. A slower rate of sea level rise enables greater opportunities for adaptation in the human and ecological systems of small islands, low-lying coastal areas and deltas (*medium confidence*). {3.3, 3.4, 3.6}**

B.2.1 Model-based projections of global mean sea level rise (relative to 1986–2005) suggest an indicative range of 0.26 to 0.77 m by 2100 for 1.5°C of global warming, 0.1 m (0.04–0.16 m) less than for a global warming of 2°C (*medium confidence*). A reduction of 0.1 m in global sea level rise implies that up to 10 million fewer people would be exposed to related risks, based on population in the year 2010 and assuming no adaptation (*medium confidence*). {3.4.4, 3.4.5, 4.3.2}

B.2.2 Sea level rise will continue beyond 2100 even if global warming is limited to 1.5°C in the 21st century (*high confidence*). Marine ice sheet instability in Antarctica and/or irreversible loss of the Greenland ice sheet could result in multi-metre rise in sea level over hundreds to thousands of years. These instabilities could be triggered at around 1.5°C to 2°C of global warming (*medium confidence*). (Figure SPM.2) {3.3.9, 3.4.5, 3.5.2, 3.6.3, Box 3.3}

<sup>7</sup> Robust is here used to mean that at least two thirds of climate models show the same sign of changes at the grid point scale, and that differences in large regions are statistically significant.

<sup>8</sup> Projected changes in impacts between different levels of global warming are determined with respect to changes in global mean surface air temperature.



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

## Summary for Policymakers

SPM

- B.2.3** Increasing warming amplifies the exposure of small islands, low-lying coastal areas and deltas to the risks associated with sea level rise for many human and ecological systems, including increased saltwater intrusion, flooding and damage to infrastructure (*high confidence*). Risks associated with sea level rise are higher at 2°C compared to 1.5°C. The slower rate of sea level rise at global warming of 1.5°C reduces these risks, enabling greater opportunities for adaptation including managing and restoring natural coastal ecosystems and infrastructure reinforcement (*medium confidence*). (Figure SPM.2) {3.4.5, Box 3.5}
- B.3** **On land, impacts on biodiversity and ecosystems, including species loss and extinction, are projected to be lower at 1.5°C of global warming compared to 2°C. Limiting global warming to 1.5°C compared to 2°C is projected to lower the impacts on terrestrial, freshwater and coastal ecosystems and to retain more of their services to humans (*high confidence*). (Figure SPM.2) {3.4, 3.5, Box 3.4, Box 4.2, Cross-Chapter Box 8 in Chapter 3}**
- B.3.1** Of 105,000 species studied,<sup>9</sup> 6% of insects, 8% of plants and 4% of vertebrates are projected to lose over half of their climatically determined geographic range for global warming of 1.5°C, compared with 18% of insects, 16% of plants and 8% of vertebrates for global warming of 2°C (*medium confidence*). Impacts associated with other biodiversity-related risks such as forest fires and the spread of invasive species are lower at 1.5°C compared to 2°C of global warming (*high confidence*). {3.4.3, 3.5.2}
- B.3.2** Approximately 4% (interquartile range 2–7%) of the global terrestrial land area is projected to undergo a transformation of ecosystems from one type to another at 1°C of global warming, compared with 13% (interquartile range 8–20%) at 2°C (*medium confidence*). This indicates that the area at risk is projected to be approximately 50% lower at 1.5°C compared to 2°C (*medium confidence*). {3.4.3.1, 3.4.3.5}
- B.3.3** High-latitude tundra and boreal forests are particularly at risk of climate change-induced degradation and loss, with woody shrubs already encroaching into the tundra (*high confidence*) and this will proceed with further warming. Limiting global warming to 1.5°C rather than 2°C is projected to prevent the thawing over centuries of a permafrost area in the range of 1.5 to 2.5 million km<sup>2</sup> (*medium confidence*). {3.3.2, 3.4.3, 3.5.5}
- B.4** **Limiting global warming to 1.5°C compared to 2°C is projected to reduce increases in ocean temperature as well as associated increases in ocean acidity and decreases in ocean oxygen levels (*high confidence*). Consequently, limiting global warming to 1.5°C is projected to reduce risks to marine biodiversity, fisheries, and ecosystems, and their functions and services to humans, as illustrated by recent changes to Arctic sea ice and warm-water coral reef ecosystems (*high confidence*). {3.3, 3.4, 3.5, Box 3.4, Box 3.5}**
- B.4.1** There is *high confidence* that the probability of a sea ice-free Arctic Ocean during summer is substantially lower at global warming of 1.5°C when compared to 2°C. With 1.5°C of global warming, one sea ice-free Arctic summer is projected per century. This likelihood is increased to at least one per decade with 2°C global warming. Effects of a temperature overshoot are reversible for Arctic sea ice cover on decadal time scales (*high confidence*). {3.3.8, 3.4.4.7}
- B.4.2** Global warming of 1.5°C is projected to shift the ranges of many marine species to higher latitudes as well as increase the amount of damage to many ecosystems. It is also expected to drive the loss of coastal resources and reduce the productivity of fisheries and aquaculture (especially at low latitudes). The risks of climate-induced impacts are projected to be higher at 2°C than those at global warming of 1.5°C (*high confidence*). Coral reefs, for example, are projected to decline by a further 70–90% at 1.5°C (*high confidence*) with larger losses (>99%) at 2°C (*very high confidence*). The risk of irreversible loss of many marine and coastal ecosystems increases with global warming, especially at 2°C or more (*high confidence*). {3.4.4, Box 3.4}

<sup>9</sup> Consistent with earlier studies, illustrative numbers were adopted from one recent meta-study.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

- B.4.3 The level of ocean acidification due to increasing CO<sub>2</sub> concentrations associated with global warming of 1.5°C is projected to amplify the adverse effects of warming, and even further at 2°C, impacting the growth, development, calcification, survival, and thus abundance of a broad range of species, for example, from algae to fish (*high confidence*). {3.3.10, 3.4.4}
- B.4.4 Impacts of climate change in the ocean are increasing risks to fisheries and aquaculture via impacts on the physiology, survivorship, habitat, reproduction, disease incidence, and risk of invasive species (*medium confidence*) but are projected to be less at 1.5°C of global warming than at 2°C. One global fishery model, for example, projected a decrease in global annual catch for marine fisheries of about 1.5 million tonnes for 1.5°C of global warming compared to a loss of more than 3 million tonnes for 2°C of global warming (*medium confidence*). {3.4.4, Box 3.4}
- B.5 Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C. (Figure SPM.2) {3.4, 3.5, 5.2, Box 3.2, Box 3.3, Box 3.5, Box 3.6, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5, 5.2}**
- B.5.1 Populations at disproportionately higher risk of adverse consequences with global warming of 1.5°C and beyond include disadvantaged and vulnerable populations, some indigenous peoples, and local communities dependent on agricultural or coastal livelihoods (*high confidence*). Regions at disproportionately higher risk include Arctic ecosystems, dryland regions, small island developing states, and Least Developed Countries (*high confidence*). Poverty and disadvantage are expected to increase in some populations as global warming increases; limiting global warming to 1.5°C, compared with 2°C, could reduce the number of people both exposed to climate-related risks and susceptible to poverty by up to several hundred million by 2050 (*medium confidence*). {3.4.10, 3.4.11, Box 3.5, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5, 4.2.2.2, 5.2.1, 5.2.2, 5.2.3, 5.6.3}
- B.5.2 Any increase in global warming is projected to affect human health, with primarily negative consequences (*high confidence*). Lower risks are projected at 1.5°C than at 2°C for heat-related morbidity and mortality (*very high confidence*) and for ozone-related mortality if emissions needed for ozone formation remain high (*high confidence*). Urban heat islands often amplify the impacts of heatwaves in cities (*high confidence*). Risks from some vector-borne diseases, such as malaria and dengue fever, are projected to increase with warming from 1.5°C to 2°C, including potential shifts in their geographic range (*high confidence*). {3.4.7, 3.4.8, 3.5.5.8}
- B.5.3 Limiting warming to 1.5°C compared with 2°C is projected to result in smaller net reductions in yields of maize, rice, wheat, and potentially other cereal crops, particularly in sub-Saharan Africa, Southeast Asia, and Central and South America, and in the CO<sub>2</sub>-dependent nutritional quality of rice and wheat (*high confidence*). Reductions in projected food availability are larger at 2°C than at 1.5°C of global warming in the Sahel, southern Africa, the Mediterranean, central Europe, and the Amazon (*medium confidence*). Livestock are projected to be adversely affected with rising temperatures, depending on the extent of changes in feed quality, spread of diseases, and water resource availability (*high confidence*). {3.4.6, 3.5.4, 3.5.5, Box 3.1, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4}
- B.5.4 Depending on future socio-economic conditions, limiting global warming to 1.5°C compared to 2°C may reduce the proportion of the world population exposed to a climate change-induced increase in water stress by up to 50%, although there is considerable variability between regions (*medium confidence*). Many small island developing states could experience lower water stress as a result of projected changes in aridity when global warming is limited to 1.5°C, as compared to 2°C (*medium confidence*). {3.3.5, 3.4.2, 3.4.8, 3.5.5, Box 3.2, Box 3.5, Cross-Chapter Box 9 in Chapter 4}
- B.5.5 Risks to global aggregated economic growth due to climate change impacts are projected to be lower at 1.5°C than at 2°C by the end of this century<sup>10</sup> (*medium confidence*). This excludes the costs of mitigation, adaptation investments and the benefits of adaptation. Countries in the tropics and Southern Hemisphere subtropics are projected to experience the largest impacts on economic growth due to climate change should global warming increase from 1.5°C to 2°C (*medium confidence*). {3.5.2, 3.5.3}

<sup>10</sup> Here, impacts on economic growth refer to changes in gross domestic product (GDP). Many impacts, such as loss of human lives, cultural heritage and ecosystem services, are difficult to value and monetize.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

## Summary for Policymakers

SPM

- B.5.6 Exposure to multiple and compound climate-related risks increases between 1.5°C and 2°C of global warming, with greater proportions of people both so exposed and susceptible to poverty in Africa and Asia (*high confidence*). For global warming from 1.5°C to 2°C, risks across energy, food, and water sectors could overlap spatially and temporally, creating new and exacerbating current hazards, exposures, and vulnerabilities that could affect increasing numbers of people and regions (*medium confidence*). {Box 3.5, 3.3.1, 3.4.5.3, 3.4.5.6, 3.4.11, 3.5.4.9}
- B.5.7 There are multiple lines of evidence that since AR5 the assessed levels of risk increased for four of the five Reasons for Concern (RFCs) for global warming to 2°C (*high confidence*). The risk transitions by degrees of global warming are now: from high to very high risk between 1.5°C and 2°C for RFC1 (Unique and threatened systems) (*high confidence*); from moderate to high risk between 1°C and 1.5°C for RFC2 (Extreme weather events) (*medium confidence*); from moderate to high risk between 1.5°C and 2°C for RFC3 (Distribution of impacts) (*high confidence*); from moderate to high risk between 1.5°C and 2.5°C for RFC4 (Global aggregate impacts) (*medium confidence*); and from moderate to high risk between 1°C and 2.5°C for RFC5 (Large-scale singular events) (*medium confidence*). (Figure SPM.2) {3.4.13; 3.5, 3.5.2}
- B.6 Most adaptation needs will be lower for global warming of 1.5°C compared to 2°C (*high confidence*). There are a wide range of adaptation options that can reduce the risks of climate change (*high confidence*). There are limits to adaptation and adaptive capacity for some human and natural systems at global warming of 1.5°C, with associated losses (*medium confidence*). The number and availability of adaptation options vary by sector (*medium confidence*). {Table 3.5, 4.3, 4.5, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5}**
- B.6.1 A wide range of adaptation options are available to reduce the risks to natural and managed ecosystems (e.g., ecosystem-based adaptation, ecosystem restoration and avoided degradation and deforestation, biodiversity management, sustainable aquaculture, and local knowledge and indigenous knowledge), the risks of sea level rise (e.g., coastal defence and hardening), and the risks to health, livelihoods, food, water, and economic growth, especially in rural landscapes (e.g., efficient irrigation, social safety nets, disaster risk management, risk spreading and sharing, and community-based adaptation) and urban areas (e.g., green infrastructure, sustainable land use and planning, and sustainable water management) (*medium confidence*). {4.3.1, 4.3.2, 4.3.3, 4.3.5, 4.5.3, 4.5.4, 5.3.2, Box 4.2, Box 4.3, Box 4.6, Cross-Chapter Box 9 in Chapter 4}.
- B.6.2 Adaptation is expected to be more challenging for ecosystems, food and health systems at 2°C of global warming than for 1.5°C (*medium confidence*). Some vulnerable regions, including small islands and Least Developed Countries, are projected to experience high multiple interrelated climate risks even at global warming of 1.5°C (*high confidence*). {3.3.1, 3.4.5, Box 3.5, Table 3.5, Cross-Chapter Box 9 in Chapter 4, 5.6, Cross-Chapter Box 12 in Chapter 5, Box 5.3}
- B.6.3 Limits to adaptive capacity exist at 1.5°C of global warming, become more pronounced at higher levels of warming and vary by sector, with site-specific implications for vulnerable regions, ecosystems and human health (*medium confidence*). {Cross-Chapter Box 12 in Chapter 5, Box 3.5, Table 3.5}

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

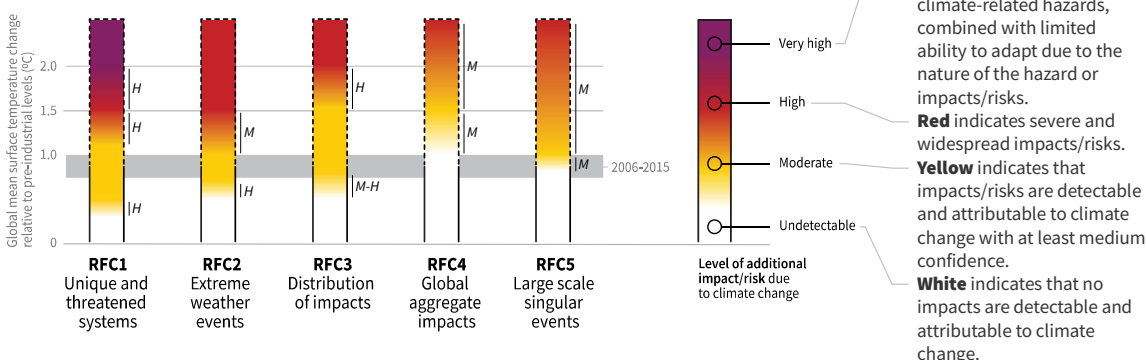
Summary for Policymakers

SPM

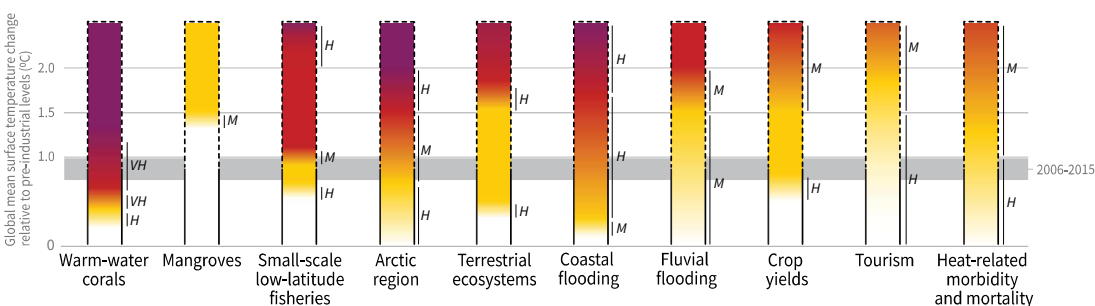
## How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

### Impacts and risks associated with the Reasons for Concern (RFCs)



### Impacts and risks for selected natural, managed and human systems



Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high

**Figure SPM.2** | Five integrative reasons for concern (RFCs) provide a framework for summarizing key impacts and risks across sectors and regions, and were introduced in the IPCC Third Assessment Report. RFCs illustrate the implications of global warming for people, economies and ecosystems. Impacts and/or risks for each RFC are based on assessment of the new literature that has appeared. As in AR5, this literature was used to make expert judgments to assess the levels of global warming at which levels of impact and/or risk are undetectable, moderate, high or very high. The selection of impacts and risks to natural, managed and human systems in the lower panel is illustrative and is not intended to be fully comprehensive. {3.4, 3.5, 3.5.2.1, 3.5.2.2, 3.5.2.3, 3.5.2.4, 3.5.2.5, 5.4.1, 5.5.3, 5.6.1, Box 3.4}

**RFC1 Unique and threatened systems:** ecological and human systems that have restricted geographic ranges constrained by climate-related conditions and have high endemism or other distinctive properties. Examples include coral reefs, the Arctic and its indigenous people, mountain glaciers and biodiversity hotspots.

**RFC2 Extreme weather events:** risks/impacts to human health, livelihoods, assets and ecosystems from extreme weather events such as heat waves, heavy rain, drought and associated wildfires, and coastal flooding.

**RFC3 Distribution of impacts:** risks/impacts that disproportionately affect particular groups due to uneven distribution of physical climate change hazards, exposure or vulnerability.

**RFC4 Global aggregate impacts:** global monetary damage, global-scale degradation and loss of ecosystems and biodiversity.

**RFC5 Large-scale singular events:** are relatively large, abrupt and sometimes irreversible changes in systems that are caused by global warming. Examples include disintegration of the Greenland and Antarctic ice sheets.

## C. Emission Pathways and System Transitions Consistent with 1.5°C Global Warming

- C.1 In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO<sub>2</sub> emissions decline by about 45% from 2010 levels by 2030 (40–60% interquartile range), reaching net zero around 2050 (2045–2055 interquartile range). For limiting global warming to below 2°C<sup>11</sup> CO<sub>2</sub> emissions are projected to decline by about 25% by 2030 in most pathways (10–30% interquartile range) and reach net zero around 2070 (2065–2080 interquartile range). Non-CO<sub>2</sub> emissions in pathways that limit global warming to 1.5°C show deep reductions that are similar to those in pathways limiting warming to 2°C. (*high confidence*) (Figure SPM.3a) {2.1, 2.3, Table 2.4}**
- C.1.1** CO<sub>2</sub> emissions reductions that limit global warming to 1.5°C with no or limited overshoot can involve different portfolios of mitigation measures, striking different balances between lowering energy and resource intensity, rate of decarbonization, and the reliance on carbon dioxide removal. Different portfolios face different implementation challenges and potential synergies and trade-offs with sustainable development. (*high confidence*) (Figure SPM.3b) {2.3.2, 2.3.4, 2.4, 2.5.3}
- C.1.2** Modelled pathways that limit global warming to 1.5°C with no or limited overshoot involve deep reductions in emissions of methane and black carbon (35% or more of both by 2050 relative to 2010). These pathways also reduce most of the cooling aerosols, which partially offsets mitigation effects for two to three decades. Non-CO<sub>2</sub> emissions<sup>12</sup> can be reduced as a result of broad mitigation measures in the energy sector. In addition, targeted non-CO<sub>2</sub> mitigation measures can reduce nitrous oxide and methane from agriculture, methane from the waste sector, some sources of black carbon, and hydrofluorocarbons. High bioenergy demand can increase emissions of nitrous oxide in some 1.5°C pathways, highlighting the importance of appropriate management approaches. Improved air quality resulting from projected reductions in many non-CO<sub>2</sub> emissions provide direct and immediate population health benefits in all 1.5°C model pathways. (*high confidence*) (Figure SPM.3a) {2.2.1, 2.3.3, 2.4.4, 2.5.3, 4.3.6, 5.4.2}
- C.1.3** Limiting global warming requires limiting the total cumulative global anthropogenic emissions of CO<sub>2</sub> since the pre-industrial period, that is, staying within a total carbon budget (*high confidence*).<sup>13</sup> By the end of 2017, anthropogenic CO<sub>2</sub> emissions since the pre-industrial period are estimated to have reduced the total carbon budget for 1.5°C by approximately 2200 ± 320 GtCO<sub>2</sub> (*medium confidence*). The associated remaining budget is being depleted by current emissions of 42 ± 3 GtCO<sub>2</sub> per year (*high confidence*). The choice of the measure of global temperature affects the estimated remaining carbon budget. Using global mean surface air temperature, as in AR5, gives an estimate of the remaining carbon budget of 580 GtCO<sub>2</sub> for a 50% probability of limiting warming to 1.5°C, and 420 GtCO<sub>2</sub> for a 66% probability (*medium confidence*).<sup>14</sup> Alternatively, using GMST gives estimates of 770 and 570 GtCO<sub>2</sub>, for 50% and 66% probabilities,<sup>15</sup> respectively (*medium confidence*). Uncertainties in the size of these estimated remaining carbon budgets are substantial and depend on several factors. Uncertainties in the climate response to CO<sub>2</sub> and non-CO<sub>2</sub> emissions contribute ±400 GtCO<sub>2</sub>, and the level of historic warming contributes ±250 GtCO<sub>2</sub> (*medium confidence*). Potential additional carbon release from future permafrost thawing and methane release from wetlands would reduce budgets by up to 100 GtCO<sub>2</sub> over the course of this century and more thereafter (*medium confidence*). In addition, the level of non-CO<sub>2</sub> mitigation in the future could alter the remaining carbon budget by 250 GtCO<sub>2</sub> in either direction (*medium confidence*). {1.2.4, 2.2.2, 2.6.1, Table 2.2, Chapter 2 Supplementary Material}
- C.1.4** Solar radiation modification (SRM) measures are not included in any of the available assessed pathways. Although some SRM measures may be theoretically effective in reducing an overshoot, they face large uncertainties and knowledge gaps

<sup>11</sup> References to pathways limiting global warming to 2°C are based on a 66% probability of staying below 2°C.

<sup>12</sup> Non-CO<sub>2</sub> emissions included in this Report are all anthropogenic emissions other than CO<sub>2</sub> that result in radiative forcing. These include short-lived climate forcers, such as methane, some fluorinated gases, ozone precursors, aerosols or aerosol precursors, such as black carbon and sulphur dioxide, respectively, as well as long-lived greenhouse gases, such as nitrous oxide or some fluorinated gases. The radiative forcing associated with non-CO<sub>2</sub> emissions and changes in surface albedo is referred to as non-CO<sub>2</sub> radiative forcing. {2.2.1}

<sup>13</sup> There is a clear scientific basis for a total carbon budget consistent with limiting global warming to 1.5°C. However, neither this total carbon budget nor the fraction of this budget taken up by past emissions were assessed in this Report.

<sup>14</sup> Irrespective of the measure of global temperature used, updated understanding and further advances in methods have led to an increase in the estimated remaining carbon budget of about 300 GtCO<sub>2</sub> compared to AR5. (*medium confidence*) {2.2.2}

<sup>15</sup> These estimates use observed GMST to 2006–2015 and estimate future temperature changes using near surface air temperatures.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

as well as substantial risks and institutional and social constraints to deployment related to governance, ethics, and impacts on sustainable development. They also do not mitigate ocean acidification. (*medium confidence*) {4.3.8, Cross-Chapter Box 10 in Chapter 4}

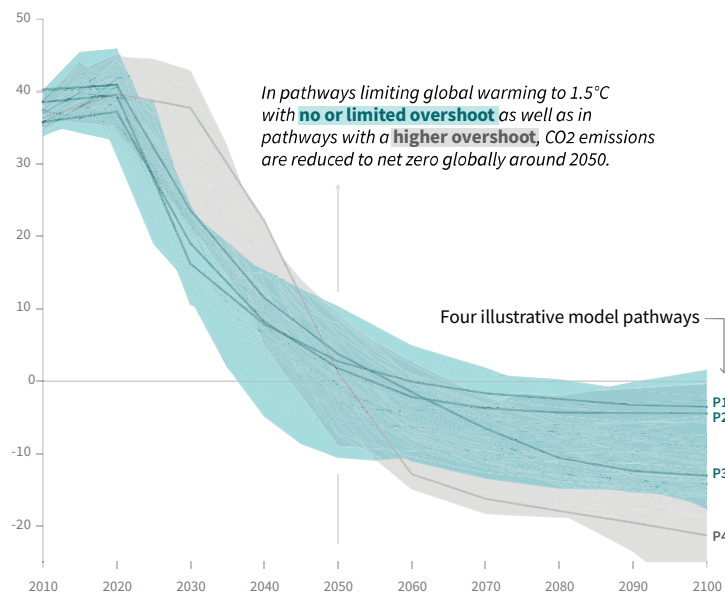
SPM

## Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO<sub>2</sub>, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM.3b.

### Global total net CO<sub>2</sub> emissions

Billion tonnes of CO<sub>2</sub>/yr



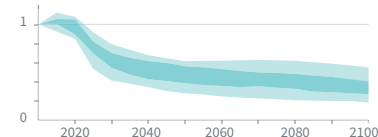
Timing of net zero CO<sub>2</sub>  
Line widths depict the 5-95th  
percentile and the 25-75th  
percentile of scenarios



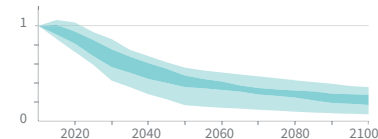
### Non-CO<sub>2</sub> emissions relative to 2010

Emissions of non-CO<sub>2</sub> forcers are also reduced or limited in pathways limiting global warming to 1.5°C with no or limited overshoot, but they do not reach zero globally.

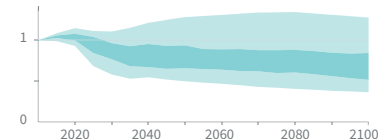
#### Methane emissions



#### Black carbon emissions



#### Nitrous oxide emissions



**Figure SPM.3a** | Global emissions pathway characteristics. The main panel shows global net anthropogenic CO<sub>2</sub> emissions in pathways limiting global warming to 1.5°C with no or limited (less than 0.1°C) overshoot and pathways with higher overshoot. The shaded area shows the full range for pathways analysed in this Report. The panels on the right show non-CO<sub>2</sub> emissions ranges for three compounds with large historical forcing and a substantial portion of emissions coming from sources distinct from those central to CO<sub>2</sub> mitigation. Shaded areas in these panels show the 5–95% (light shading) and interquartile (dark shading) ranges of pathways limiting global warming to 1.5°C with no or limited overshoot. Box and whiskers at the bottom of the figure show the timing of pathways reaching global net zero CO<sub>2</sub> emission levels, and a comparison with pathways limiting global warming to 2°C with at least 66% probability. Four illustrative model pathways are highlighted in the main panel and are labelled P1, P2, P3 and P4, corresponding to the LED, S1, S2, and S5 pathways assessed in Chapter 2. Descriptions and characteristics of these pathways are available in Figure SPM.3b. {2.1, 2.2, 2.3, Figure 2.5, Figure 2.10, Figure 2.11}



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

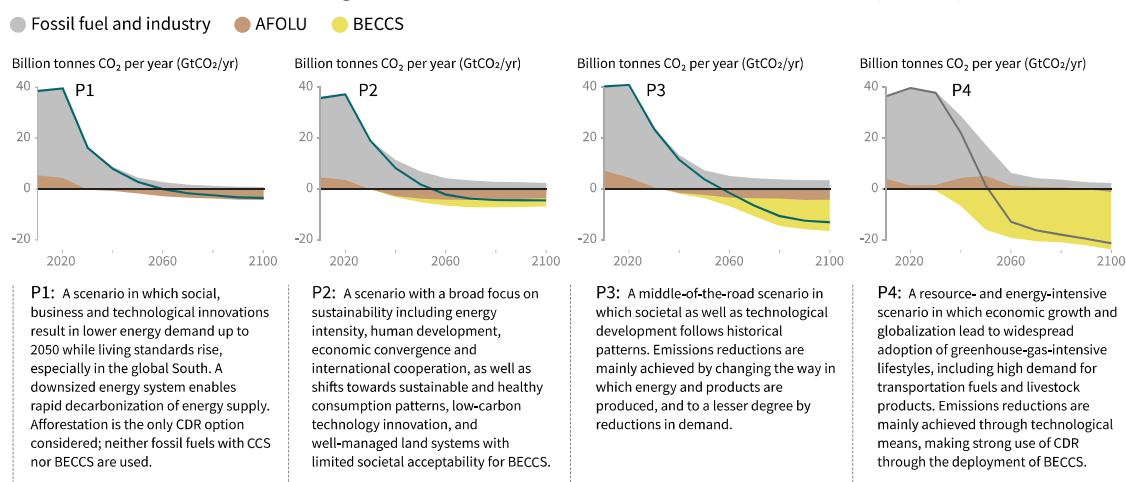
## Summary for Policymakers

SPM

## Characteristics of four illustrative model pathways

Different mitigation strategies can achieve the net emissions reductions that would be required to follow a pathway that limits global warming to 1.5°C with no or limited overshoot. All pathways use Carbon Dioxide Removal (CDR), but the amount varies across pathways, as do the relative contributions of Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry and Other Land Use (AFOLU) sector. This has implications for emissions and several other pathway characteristics.

## Breakdown of contributions to global net CO<sub>2</sub> emissions in four illustrative model pathways



Global indicators	P1	P2	P3	P4	Interquartile range
<b>Pathway classification</b>	No or limited overshoot	No or limited overshoot	No or limited overshoot	Higher overshoot	No or limited overshoot
CO <sub>2</sub> emission change in 2030 (% rel to 2010)	-58	-47	-41	4	(-58,-40)
↳ in 2050 (% rel to 2010)	-93	-95	-91	-97	(-107,-94)
Kyoto-GHG emissions* in 2030 (% rel to 2010)	-50	-49	-35	-2	(-51,-39)
↳ in 2050 (% rel to 2010)	-82	-89	-78	-80	(-93,-81)
Final energy demand** in 2030 (% rel to 2010)	-15	-5	17	39	(-12,7)
↳ in 2050 (% rel to 2010)	-32	2	21	44	(-11,22)
Renewable share in electricity in 2030 (%)	60	58	48	25	(47,65)
↳ in 2050 (%)	77	81	63	70	(69,86)
Primary energy from coal in 2030 (% rel to 2010)	-78	-61	-75	-59	(-78,-59)
↳ in 2050 (% rel to 2010)	-97	-77	-73	-97	(-95,-74)
from oil in 2030 (% rel to 2010)	-37	-13	-3	86	(-34,3)
↳ in 2050 (% rel to 2010)	-87	-50	-81	-32	(-78,-31)
from gas in 2030 (% rel to 2010)	-25	-20	33	37	(-26,21)
↳ in 2050 (% rel to 2010)	-74	-53	21	-48	(-56,6)
from nuclear in 2030 (% rel to 2010)	59	83	98	106	(44,102)
↳ in 2050 (% rel to 2010)	150	98	501	468	(91,190)
from biomass in 2030 (% rel to 2010)	-11	0	36	-1	(29,80)
↳ in 2050 (% rel to 2010)	-16	49	121	418	(123,261)
from non-biomass renewables in 2030 (% rel to 2010)	430	470	315	110	(245,436)
↳ in 2050 (% rel to 2010)	833	1327	878	1137	(576,1299)
Cumulative CCS until 2100 (GtCO <sub>2</sub> )	0	348	687	1218	(550,1017)
↳ of which BECCS (GtCO <sub>2</sub> )	0	151	414	1191	(364,662)
Land area of bioenergy crops in 2050 (million km <sup>2</sup> )	0.2	0.9	2.8	7.2	(1.5,3.2)
Agricultural CH <sub>4</sub> emissions in 2030 (% rel to 2010)	-24	-48	1	14	(-30,-11)
↳ in 2050 (% rel to 2010)	-33	-69	-23	2	(-47,-24)
Agricultural N <sub>2</sub> O emissions in 2030 (% rel to 2010)	5	-26	15	3	(-21,3)
↳ in 2050 (% rel to 2010)	6	-26	0	39	(-26,1)

NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment. National and sectoral characteristics can differ substantially from the global trends shown above.

\* Kyoto-gas emissions are based on IPCC Second Assessment Report GWP-100  
\*\* Changes in energy demand are associated with improvements in energy efficiency and behaviour change

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

**Figure SPM.3b** | Characteristics of four illustrative model pathways in relation to global warming of 1.5°C introduced in Figure SPM.3a. These pathways were selected to show a range of potential mitigation approaches and vary widely in their projected energy and land use, as well as their assumptions about future socio-economic developments, including economic and population growth, equity and sustainability. A breakdown of the global net anthropogenic CO<sub>2</sub> emissions into the contributions in terms of CO<sub>2</sub> emissions from fossil fuel and industry; agriculture, forestry and other land use (AFOLU); and bioenergy with carbon capture and storage (BECCS) is shown. AFOLU estimates reported here are not necessarily comparable with countries' estimates. Further characteristics for each of these pathways are listed below each pathway. These pathways illustrate relative global differences in mitigation strategies, but do not represent central estimates, national strategies, and do not indicate requirements. For comparison, the right-most column shows the interquartile ranges across pathways with no or limited overshoot of 1.5°C. Pathways P1, P2, P3 and P4 correspond to the LED, S1, S2 and S5 pathways assessed in Chapter 2 (Figure SPM.3a). {2.2.1, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.4.1, 2.4.2, 2.4.4, 2.5.3, Figure 2.5, Figure 2.6, Figure 2.9, Figure 2.10, Figure 2.11, Figure 2.14, Figure 2.15, Figure 2.16, Figure 2.17, Figure 2.24, Figure 2.25, Table 2.4, Table 2.6, Table 2.7, Table 2.9, Table 4.1}

**C.2 Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (*high confidence*). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (*medium confidence*). {2.3, 2.4, 2.5, 4.2, 4.3, 4.4, 4.5}**

**C.2.1** Pathways that limit global warming to 1.5°C with no or limited overshoot show system changes that are more rapid and pronounced over the next two decades than in 2°C pathways (*high confidence*). The rates of system changes associated with limiting global warming to 1.5°C with no or limited overshoot have occurred in the past within specific sectors, technologies and spatial contexts, but there is no documented historic precedent for their scale (*medium confidence*). {2.3.3, 2.3.4, 2.4, 2.5, 4.2.1, 4.2.2, Cross-Chapter Box 11 in Chapter 4}

**C.2.2** In energy systems, modelled global pathways (considered in the literature) limiting global warming to 1.5°C with no or limited overshoot (for more details see Figure SPM.3b) generally meet energy service demand with lower energy use, including through enhanced energy efficiency, and show faster electrification of energy end use compared to 2°C (*high confidence*). In 1.5°C pathways with no or limited overshoot, low-emission energy sources are projected to have a higher share, compared with 2°C pathways, particularly before 2050 (*high confidence*). In 1.5°C pathways with no or limited overshoot, renewables are projected to supply 70–85% (interquartile range) of electricity in 2050 (*high confidence*). In electricity generation, shares of nuclear and fossil fuels with carbon dioxide capture and storage (CCS) are modelled to increase in most 1.5°C pathways with no or limited overshoot. In modelled 1.5°C pathways with limited or no overshoot, the use of CCS would allow the electricity generation share of gas to be approximately 8% (3–11% interquartile range) of global electricity in 2050, while the use of coal shows a steep reduction in all pathways and would be reduced to close to 0% (0–2% interquartile range) of electricity (*high confidence*). While acknowledging the challenges, and differences between the options and national circumstances, political, economic, social and technical feasibility of solar energy, wind energy and electricity storage technologies have substantially improved over the past few years (*high confidence*). These improvements signal a potential system transition in electricity generation. (Figure SPM.3b) {2.4.1, 2.4.2, Figure 2.1, Table 2.6, Table 2.7, Cross-Chapter Box 6 in Chapter 3, 4.2.1, 4.3.1, 4.3.3, 4.5.2}

**C.2.3** CO<sub>2</sub> emissions from industry in pathways limiting global warming to 1.5°C with no or limited overshoot are projected to be about 65–90% (interquartile range) lower in 2050 relative to 2010, as compared to 50–80% for global warming of 2°C (*medium confidence*). Such reductions can be achieved through combinations of new and existing technologies and practices, including electrification, hydrogen, sustainable bio-based feedstocks, product substitution, and carbon capture, utilization and storage (CCUS). These options are technically proven at various scales but their large-scale deployment may be limited by economic, financial, human capacity and institutional constraints in specific contexts, and specific characteristics of large-scale industrial installations. In industry, emissions reductions by energy and process efficiency by themselves are insufficient for limiting warming to 1.5°C with no or limited overshoot (*high confidence*). {2.4.3, 4.2.1, Table 4.1, Table 4.3, 4.3.3, 4.3.4, 4.5.2}

**C.2.4** The urban and infrastructure system transition consistent with limiting global warming to 1.5°C with no or limited overshoot would imply, for example, changes in land and urban planning practices, as well as deeper emissions reductions in transport and buildings compared to pathways that limit global warming below 2°C (*medium confidence*). Technical measures



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

## Summary for Policymakers

SPM

and practices enabling deep emissions reductions include various energy efficiency options. In pathways limiting global warming to 1.5°C with no or limited overshoot, the electricity share of energy demand in buildings would be about 55–75% in 2050 compared to 50–70% in 2050 for 2°C global warming (*medium confidence*). In the transport sector, the share of low-emission final energy would rise from less than 5% in 2020 to about 35–65% in 2050 compared to 25–45% for 2°C of global warming (*medium confidence*). Economic, institutional and socio-cultural barriers may inhibit these urban and infrastructure system transitions, depending on national, regional and local circumstances, capabilities and the availability of capital (*high confidence*). {2.3.4, 2.4.3, 4.2.1, Table 4.1, 4.3.3, 4.5.2}

- C.2.5 Transitions in global and regional land use are found in all pathways limiting global warming to 1.5°C with no or limited overshoot, but their scale depends on the pursued mitigation portfolio. Model pathways that limit global warming to 1.5°C with no or limited overshoot project a 4 million km<sup>2</sup> reduction to a 2.5 million km<sup>2</sup> increase of non-pasture agricultural land for food and feed crops and a 0.5–11 million km<sup>2</sup> reduction of pasture land, to be converted into a 0–6 million km<sup>2</sup> increase of agricultural land for energy crops and a 2 million km<sup>2</sup> reduction to 9.5 million km<sup>2</sup> increase in forests by 2050 relative to 2010 (*medium confidence*).<sup>16</sup> Land-use transitions of similar magnitude can be observed in modelled 2°C pathways (*medium confidence*). Such large transitions pose profound challenges for sustainable management of the various demands on land for human settlements, food, livestock feed, fibre, bioenergy, carbon storage, biodiversity and other ecosystem services (*high confidence*). Mitigation options limiting the demand for land include sustainable intensification of land-use practices, ecosystem restoration and changes towards less resource-intensive diets (*high confidence*). The implementation of land-based mitigation options would require overcoming socio-economic, institutional, technological, financing and environmental barriers that differ across regions (*high confidence*). {2.4.4, Figure 2.24, 4.3.2, 4.3.7, 4.5.2, Cross-Chapter Box 7 in Chapter 3}
- C.2.6 Additional annual average energy-related investments for the period 2016 to 2050 in pathways limiting warming to 1.5°C compared to pathways without new climate policies beyond those in place today are estimated to be around 830 billion USD2010 (range of 150 billion to 1700 billion USD2010 across six models<sup>17</sup>). This compares to total annual average energy supply investments in 1.5°C pathways of 1460 to 3510 billion USD2010 and total annual average energy demand investments of 640 to 910 billion USD2010 for the period 2016 to 2050. Total energy-related investments increase by about 12% (range of 3% to 24%) in 1.5°C pathways relative to 2°C pathways. Annual investments in low-carbon energy technologies and energy efficiency are upscaled by roughly a factor of six (range of factor of 4 to 10) by 2050 compared to 2015 (*medium confidence*). {2.5.2, Box 4.8, Figure 2.27}
- C.2.7 Modelled pathways limiting global warming to 1.5°C with no or limited overshoot project a wide range of global average discounted marginal abatement costs over the 21st century. They are roughly 3–4 times higher than in pathways limiting global warming to below 2°C (*high confidence*). The economic literature distinguishes marginal abatement costs from total mitigation costs in the economy. The literature on total mitigation costs of 1.5°C mitigation pathways is limited and was not assessed in this Report. Knowledge gaps remain in the integrated assessment of the economy-wide costs and benefits of mitigation in line with pathways limiting warming to 1.5°C. {2.5.2; 2.6; Figure 2.26}

<sup>16</sup> The projected land-use changes presented are not deployed to their upper limits simultaneously in a single pathway.

<sup>17</sup> Including two pathways limiting warming to 1.5°C with no or limited overshoot and four pathways with higher overshoot.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

- C.3 All pathways that limit global warming to 1.5°C with limited or no overshoot project the use of carbon dioxide removal (CDR) on the order of 100–1000 GtCO<sub>2</sub> over the 21st century. CDR would be used to compensate for residual emissions and, in most cases, achieve net negative emissions to return global warming to 1.5°C following a peak (*high confidence*). CDR deployment of several hundreds of GtCO<sub>2</sub> is subject to multiple feasibility and sustainability constraints (*high confidence*). Significant near-term emissions reductions and measures to lower energy and land demand can limit CDR deployment to a few hundred GtCO<sub>2</sub> without reliance on bioenergy with carbon capture and storage (BECCS) (*high confidence*). {2.3, 2.4, 3.6.2, 4.3, 5.4}**
- C.3.1 Existing and potential CDR measures include afforestation and reforestation, land restoration and soil carbon sequestration, BECCS, direct air carbon capture and storage (DACCS), enhanced weathering and ocean alkalization. These differ widely in terms of maturity, potentials, costs, risks, co-benefits and trade-offs (*high confidence*). To date, only a few published pathways include CDR measures other than afforestation and BECCS. {2.3.4, 3.6.2, 4.3.2, 4.3.7}
- C.3.2 In pathways limiting global warming to 1.5°C with limited or no overshoot, BECCS deployment is projected to range from 0–1, 0–8, and 0–16 GtCO<sub>2</sub> yr<sup>-1</sup> in 2030, 2050, and 2100, respectively, while agriculture, forestry and land-use (AFOLU) related CDR measures are projected to remove 0–5, 1–11, and 1–5 GtCO<sub>2</sub> yr<sup>-1</sup> in these years (*medium confidence*). The upper end of these deployment ranges by mid-century exceeds the BECCS potential of up to 5 GtCO<sub>2</sub> yr<sup>-1</sup> and afforestation potential of up to 3.6 GtCO<sub>2</sub> yr<sup>-1</sup> assessed based on recent literature (*medium confidence*). Some pathways avoid BECCS deployment completely through demand-side measures and greater reliance on AFOLU-related CDR measures (*medium confidence*). The use of bioenergy can be as high or even higher when BECCS is excluded compared to when it is included due to its potential for replacing fossil fuels across sectors (*high confidence*). (Figure SPM.3b) {2.3.3, 2.3.4, 2.4.2, 3.6.2, 4.3.1, 4.2.3, 4.3.2, 4.3.7, 4.4.3, Table 2.4}
- C.3.3 Pathways that overshoot 1.5°C of global warming rely on CDR exceeding residual CO<sub>2</sub> emissions later in the century to return to below 1.5°C by 2100, with larger overshoots requiring greater amounts of CDR (Figure SPM.3b) (*high confidence*). Limitations on the speed, scale, and societal acceptability of CDR deployment hence determine the ability to return global warming to below 1.5°C following an overshoot. Carbon cycle and climate system understanding is still limited about the effectiveness of net negative emissions to reduce temperatures after they peak (*high confidence*). {2.2, 2.3.4, 2.3.5, 2.6, 4.3.7, 4.5.2, Table 4.11}
- C.3.4 Most current and potential CDR measures could have significant impacts on land, energy, water or nutrients if deployed at large scale (*high confidence*). Afforestation and bioenergy may compete with other land uses and may have significant impacts on agricultural and food systems, biodiversity, and other ecosystem functions and services (*high confidence*). Effective governance is needed to limit such trade-offs and ensure permanence of carbon removal in terrestrial, geological and ocean reservoirs (*high confidence*). Feasibility and sustainability of CDR use could be enhanced by a portfolio of options deployed at substantial, but lesser scales, rather than a single option at very large scale (*high confidence*). (Figure SPM.3b) {2.3.4, 2.4.4, 2.5.3, 2.6, 3.6.2, 4.3.2, 4.3.7, 4.5.2, 5.4.1, 5.4.2; Cross-Chapter Boxes 7 and 8 in Chapter 3, Table 4.11, Table 5.3, Figure 5.3}
- C.3.5 Some AFOLU-related CDR measures such as restoration of natural ecosystems and soil carbon sequestration could provide co-benefits such as improved biodiversity, soil quality, and local food security. If deployed at large scale, they would require governance systems enabling sustainable land management to conserve and protect land carbon stocks and other ecosystem functions and services (*medium confidence*). (Figure SPM.4) {2.3.3, 2.3.4, 2.4.2, 2.4.4, 3.6.2, 5.4.1, Cross-Chapter Boxes 3 in Chapter 1 and 7 in Chapter 3, 4.3.2, 4.3.7, 4.4.1, 4.5.2, Table 2.4}

## D. Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty

**D.1 Estimates of the global emissions outcome of current nationally stated mitigation ambitions as submitted under the Paris Agreement would lead to global greenhouse gas emissions<sup>18</sup> in 2030 of 52–58 GtCO<sub>2</sub>eq yr<sup>-1</sup> (*medium confidence*). Pathways reflecting these ambitions would not limit global warming to 1.5°C, even if supplemented by very challenging increases in the scale and ambition of emissions reductions after 2030 (*high confidence*). Avoiding overshoot and reliance on future large-scale deployment of carbon dioxide removal (CDR) can only be achieved if global CO<sub>2</sub> emissions start to decline well before 2030 (*high confidence*). {1.2, 2.3, 3.3, 3.4, 4.2, 4.4, Cross-Chapter Box 11 in Chapter 4}**

D.1.1 Pathways that limit global warming to 1.5°C with no or limited overshoot show clear emission reductions by 2030 (*high confidence*). All but one show a decline in global greenhouse gas emissions to below 35 GtCO<sub>2</sub>eq yr<sup>-1</sup> in 2030, and half of available pathways fall within the 25–30 GtCO<sub>2</sub>eq yr<sup>-1</sup> range (interquartile range), a 40–50% reduction from 2010 levels (*high confidence*). Pathways reflecting current nationally stated mitigation ambition until 2030 are broadly consistent with cost-effective pathways that result in a global warming of about 3°C by 2100, with warming continuing afterwards (*medium confidence*). {2.3.3, 2.3.5, Cross-Chapter Box 11 in Chapter 4, 5.5.3.2}

D.1.2 Overshoot trajectories result in higher impacts and associated challenges compared to pathways that limit global warming to 1.5°C with no or limited overshoot (*high confidence*). Reversing warming after an overshoot of 0.2°C or larger during this century would require upscaling and deployment of CDR at rates and volumes that might not be achievable given considerable implementation challenges (*medium confidence*). {1.3.3, 2.3.4, 2.3.5, 2.5.1, 3.3, 4.3.7, Cross-Chapter Box 8 in Chapter 3, Cross-Chapter Box 11 in Chapter 4}

D.1.3 The lower the emissions in 2030, the lower the challenge in limiting global warming to 1.5°C after 2030 with no or limited overshoot (*high confidence*). The challenges from delayed actions to reduce greenhouse gas emissions include the risk of cost escalation, lock-in in carbon-emitting infrastructure, stranded assets, and reduced flexibility in future response options in the medium to long term (*high confidence*). These may increase uneven distributional impacts between countries at different stages of development (*medium confidence*). {2.3.5, 4.4.5, 5.4.2}

**D.2 The avoided climate change impacts on sustainable development, eradication of poverty and reducing inequalities would be greater if global warming were limited to 1.5°C rather than 2°C, if mitigation and adaptation synergies are maximized while trade-offs are minimized (*high confidence*). {1.1, 1.4, 2.5, 3.3, 3.4, 5.2, Table 5.1}**

D.2.1 Climate change impacts and responses are closely linked to sustainable development which balances social well-being, economic prosperity and environmental protection. The United Nations Sustainable Development Goals (SDGs), adopted in 2015, provide an established framework for assessing the links between global warming of 1.5°C or 2°C and development goals that include poverty eradication, reducing inequalities, and climate action. (*high confidence*) {Cross-Chapter Box 4 in Chapter 1, 1.4, 5.1}

D.2.2 The consideration of ethics and equity can help address the uneven distribution of adverse impacts associated with 1.5°C and higher levels of global warming, as well as those from mitigation and adaptation, particularly for poor and disadvantaged populations, in all societies (*high confidence*). {1.1.1, 1.1.2, 1.4.3, 2.5.3, 3.4.10, 5.1, 5.2, 5.3, 5.4, Cross-Chapter Box 4 in Chapter 1, Cross-Chapter Boxes 6 and 8 in Chapter 3, and Cross-Chapter Box 12 in Chapter 5}

D.2.3 Mitigation and adaptation consistent with limiting global warming to 1.5°C are underpinned by enabling conditions, assessed in this Report across the geophysical, environmental-ecological, technological, economic, socio-cultural and institutional

<sup>18</sup> GHG emissions have been aggregated with 100-year GWP values as introduced in the IPCC Second Assessment Report.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

dimensions of feasibility. Strengthened multilevel governance, institutional capacity, policy instruments, technological innovation and transfer and mobilization of finance, and changes in human behaviour and lifestyles are enabling conditions that enhance the feasibility of mitigation and adaptation options for 1.5°C-consistent systems transitions. (*high confidence*) {1.4, Cross-Chapter Box 3 in Chapter 1, 2.5.1, 4.4, 4.5, 5.6}

**D.3 Adaptation options specific to national contexts, if carefully selected together with enabling conditions, will have benefits for sustainable development and poverty reduction with global warming of 1.5°C, although trade-offs are possible (*high confidence*). {1.4, 4.3, 4.5}**

D.3.1 Adaptation options that reduce the vulnerability of human and natural systems have many synergies with sustainable development, if well managed, such as ensuring food and water security, reducing disaster risks, improving health conditions, maintaining ecosystem services and reducing poverty and inequality (*high confidence*). Increasing investment in physical and social infrastructure is a key enabling condition to enhance the resilience and the adaptive capacities of societies. These benefits can occur in most regions with adaptation to 1.5°C of global warming (*high confidence*). {1.4.3, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.5, 4.4.1, 4.4.3, 4.5.3, 5.3.1, 5.3.2}

D.3.2 Adaptation to 1.5°C global warming can also result in trade-offs or maladaptations with adverse impacts for sustainable development. For example, if poorly designed or implemented, adaptation projects in a range of sectors can increase greenhouse gas emissions and water use, increase gender and social inequality, undermine health conditions, and encroach on natural ecosystems (*high confidence*). These trade-offs can be reduced by adaptations that include attention to poverty and sustainable development (*high confidence*). {4.3.2, 4.3.3, 4.5.4, 5.3.2; Cross-Chapter Boxes 6 and 7 in Chapter 3}

D.3.3 A mix of adaptation and mitigation options to limit global warming to 1.5°C, implemented in a participatory and integrated manner, can enable rapid, systemic transitions in urban and rural areas (*high confidence*). These are most effective when aligned with economic and sustainable development, and when local and regional governments and decision makers are supported by national governments (*medium confidence*). {4.3.2, 4.3.3, 4.4.1, 4.4.2}

D.3.4 Adaptation options that also mitigate emissions can provide synergies and cost savings in most sectors and system transitions, such as when land management reduces emissions and disaster risk, or when low-carbon buildings are also designed for efficient cooling. Trade-offs between mitigation and adaptation, when limiting global warming to 1.5°C, such as when bioenergy crops, reforestation or afforestation encroach on land needed for agricultural adaptation, can undermine food security, livelihoods, ecosystem functions and services and other aspects of sustainable development. (*high confidence*) {3.4.3, 4.3.2, 4.3.4, 4.4.1, 4.5.2, 4.5.3, 4.5.4}

**D.4 Mitigation options consistent with 1.5°C pathways are associated with multiple synergies and trade-offs across the Sustainable Development Goals (SDGs). While the total number of possible synergies exceeds the number of trade-offs, their net effect will depend on the pace and magnitude of changes, the composition of the mitigation portfolio and the management of the transition. (*high confidence*) (Figure SPM.4) {2.5, 4.5, 5.4}**

D.4.1 1.5°C pathways have robust synergies particularly for the SDGs 3 (health), 7 (clean energy), 11 (cities and communities), 12 (responsible consumption and production) and 14 (oceans) (*very high confidence*). Some 1.5°C pathways show potential trade-offs with mitigation for SDGs 1 (poverty), 2 (hunger), 6 (water) and 7 (energy access), if not managed carefully (*high confidence*). (Figure SPM.4) {5.4.2; Figure 5.4, Cross-Chapter Boxes 7 and 8 in Chapter 3}

D.4.2 1.5°C pathways that include low energy demand (e.g., see P1 in Figure SPM.3a and SPM.3b), low material consumption, and low GHG-intensive food consumption have the most pronounced synergies and the lowest number of trade-offs with respect to sustainable development and the SDGs (*high confidence*). Such pathways would reduce dependence on CDR. In modelled pathways, sustainable development, eradicating poverty and reducing inequality can support limiting warming to 1.5°C (*high confidence*). (Figure SPM.3b, Figure SPM.4) {2.4.3, 2.5.1, 2.5.3, Figure 2.4, Figure 2.28, 5.4.1, 5.4.2, Figure 5.4}

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

Summary for Policymakers

SPM

## Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.

Length shows strength of connection



The overall size of the coloured bars depict the relative potential for synergies and trade-offs between the sectoral mitigation options and the SDGs.

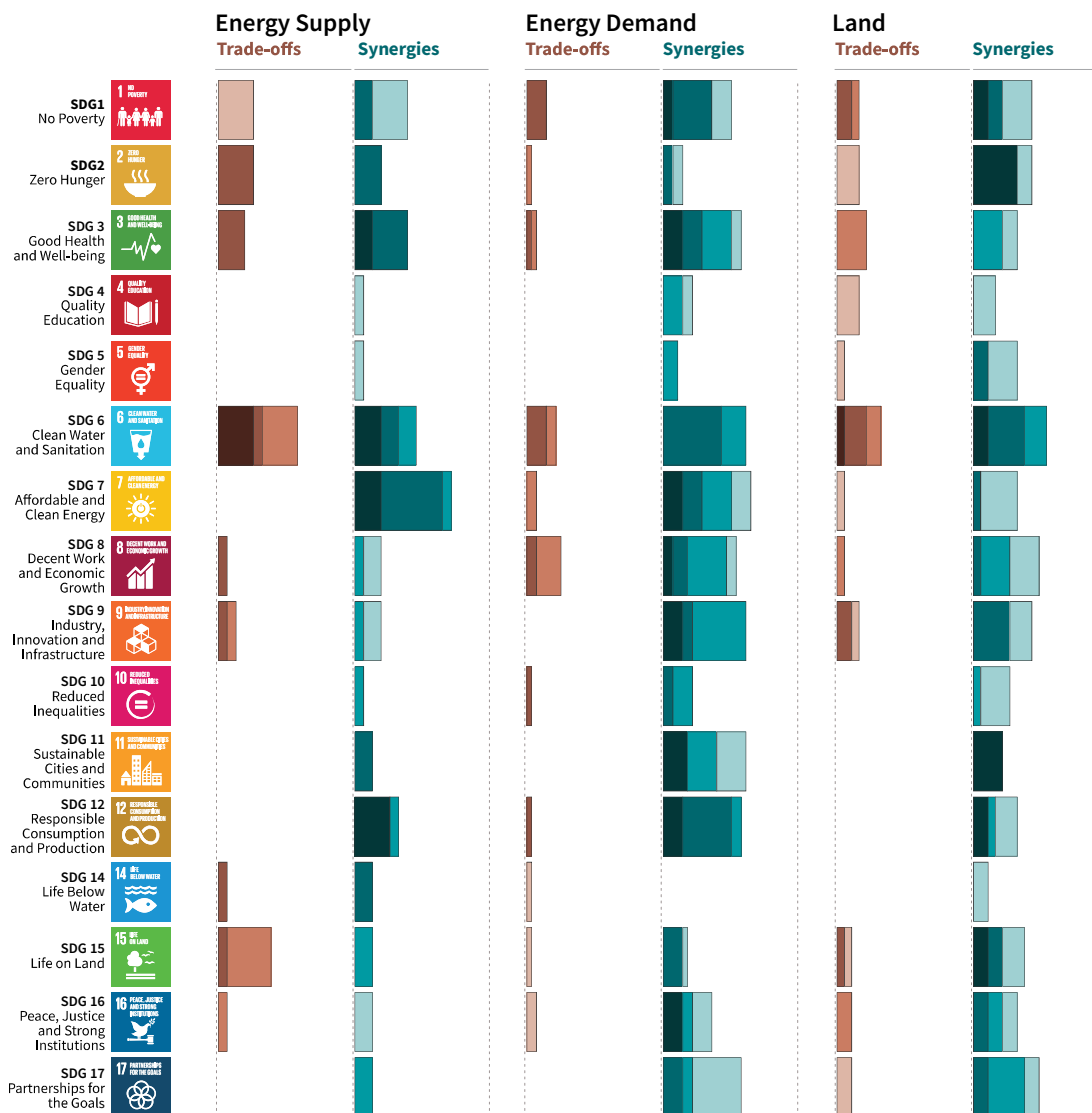
Shades show level of confidence



The shades depict the level of confidence of the assessed potential for Trade-offs/Synergies.

Very High

Low



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

**Figure SPM.4 |** Potential synergies and trade-offs between the sectoral portfolio of climate change mitigation options and the Sustainable Development Goals (SDGs). The SDGs serve as an analytical framework for the assessment of the different sustainable development dimensions, which extend beyond the time frame of the 2030 SDG targets. The assessment is based on literature on mitigation options that are considered relevant for 1.5°C. The assessed strength of the SDG interactions is based on the qualitative and quantitative assessment of individual mitigation options listed in Table 5.2. For each mitigation option, the strength of the SDG-connection as well as the associated confidence of the underlying literature (shades of green and red) was assessed. The strength of positive connections (synergies) and negative connections (trade-offs) across all individual options within a sector (see Table 5.2) are aggregated into sectoral potentials for the whole mitigation portfolio. The (white) areas outside the bars, which indicate no interactions, have *low confidence* due to the uncertainty and limited number of studies exploring indirect effects. The strength of the connection considers only the effect of mitigation and does not include benefits of avoided impacts. SDG 13 (climate action) is not listed because mitigation is being considered in terms of interactions with SDGs and not vice versa. The bars denote the strength of the connection, and do not consider the strength of the impact on the SDGs. The energy demand sector comprises behavioural responses, fuel switching and efficiency options in the transport, industry and building sector as well as carbon capture options in the industry sector. Options assessed in the energy supply sector comprise biomass and non-biomass renewables, nuclear, carbon capture and storage (CCS) with bioenergy, and CCS with fossil fuels. Options in the land sector comprise agricultural and forest options, sustainable diets and reduced food waste, soil sequestration, livestock and manure management, reduced deforestation, afforestation and reforestation, and responsible sourcing. In addition to this figure, options in the ocean sector are discussed in the underlying report, {5.4, Table 5.2, Figure 5.2}

Information about the net impacts of mitigation on sustainable development in 1.5°C pathways is available only for a limited number of SDGs and mitigation options. Only a limited number of studies have assessed the benefits of avoided climate change impacts of 1.5°C pathways for the SDGs, and the co-effects of adaptation for mitigation and the SDGs. The assessment of the indicative mitigation potentials in Figure SPM.4 is a step further from AR5 towards a more comprehensive and integrated assessment in the future.

- D.4.3 1.5°C and 2°C modelled pathways often rely on the deployment of large-scale land-related measures like afforestation and bioenergy supply, which, if poorly managed, can compete with food production and hence raise food security concerns (*high confidence*). The impacts of carbon dioxide removal (CDR) options on SDGs depend on the type of options and the scale of deployment (*high confidence*). If poorly implemented, CDR options such as BECCS and AFOLU options would lead to trade-offs. Context-relevant design and implementation requires considering people's needs, biodiversity, and other sustainable development dimensions (*very high confidence*). (Figure SPM.4) {5.4.1.3, Cross-Chapter Box 7 in Chapter 3}
- D.4.4 Mitigation consistent with 1.5°C pathways creates risks for sustainable development in regions with high dependency on fossil fuels for revenue and employment generation (*high confidence*). Policies that promote diversification of the economy and the energy sector can address the associated challenges (*high confidence*). {5.4.1.2, Box 5.2}
- D.4.5 Redistributive policies across sectors and populations that shield the poor and vulnerable can resolve trade-offs for a range of SDGs, particularly hunger, poverty and energy access. Investment needs for such complementary policies are only a small fraction of the overall mitigation investments in 1.5°C pathways. (*high confidence*) {2.4.3, 5.4.2, Figure 5.5}
- D.5 Limiting the risks from global warming of 1.5°C in the context of sustainable development and poverty eradication implies system transitions that can be enabled by an increase of adaptation and mitigation investments, policy instruments, the acceleration of technological innovation and behaviour changes (*high confidence*). {2.3, 2.4, 2.5, 3.2, 4.2, 4.4, 4.5, 5.2, 5.5, 5.6}**
- D.5.1 Directing finance towards investment in infrastructure for mitigation and adaptation could provide additional resources. This could involve the mobilization of private funds by institutional investors, asset managers and development or investment banks, as well as the provision of public funds. Government policies that lower the risk of low-emission and adaptation investments can facilitate the mobilization of private funds and enhance the effectiveness of other public policies. Studies indicate a number of challenges, including access to finance and mobilization of funds. (*high confidence*) {2.5.1, 2.5.2, 4.4.5}
- D.5.2 Adaptation finance consistent with global warming of 1.5°C is difficult to quantify and compare with 2°C. Knowledge gaps include insufficient data to calculate specific climate resilience-enhancing investments from the provision of currently underinvested basic infrastructure. Estimates of the costs of adaptation might be lower at global warming of 1.5°C than for 2°C. Adaptation needs have typically been supported by public sector sources such as national and subnational government budgets, and in developing countries together with support from development assistance, multilateral development banks, and United Nations Framework Convention on Climate Change channels (*medium confidence*). More recently there is a



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

## Summary for Policymakers

SPM

growing understanding of the scale and increase in non-governmental organizations and private funding in some regions (*medium confidence*). Barriers include the scale of adaptation financing, limited capacity and access to adaptation finance (*medium confidence*). {4.4.5, 4.6}

- D.5.3 Global model pathways limiting global warming to 1.5°C are projected to involve the annual average investment needs in the energy system of around 2.4 trillion USD2010 between 2016 and 2035, representing about 2.5% of the world GDP (*medium confidence*). {4.4.5, Box 4.8}
- D.5.4 Policy tools can help mobilize incremental resources, including through shifting global investments and savings and through market and non-market based instruments as well as accompanying measures to secure the equity of the transition, acknowledging the challenges related with implementation, including those of energy costs, depreciation of assets and impacts on international competition, and utilizing the opportunities to maximize co-benefits (*high confidence*). {1.3.3, 2.3.4, 2.3.5, 2.5.1, 2.5.2, Cross-Chapter Box 8 in Chapter 3, Cross-Chapter Box 11 in Chapter 4, 4.4.5, 5.5.2}
- D.5.5 The systems transitions consistent with adapting to and limiting global warming to 1.5°C include the widespread adoption of new and possibly disruptive technologies and practices and enhanced climate-driven innovation. These imply enhanced technological innovation capabilities, including in industry and finance. Both national innovation policies and international cooperation can contribute to the development, commercialization and widespread adoption of mitigation and adaptation technologies. Innovation policies may be more effective when they combine public support for research and development with policy mixes that provide incentives for technology diffusion. (*high confidence*) {4.4.4, 4.4.5}.
- D.5.6 Education, information, and community approaches, including those that are informed by indigenous knowledge and local knowledge, can accelerate the wide-scale behaviour changes consistent with adapting to and limiting global warming to 1.5°C. These approaches are more effective when combined with other policies and tailored to the motivations, capabilities and resources of specific actors and contexts (*high confidence*). Public acceptability can enable or inhibit the implementation of policies and measures to limit global warming to 1.5°C and to adapt to the consequences. Public acceptability depends on the individual's evaluation of expected policy consequences, the perceived fairness of the distribution of these consequences, and perceived fairness of decision procedures (*high confidence*). {1.1, 1.5, 4.3.5, 4.4.1, 4.4.3, Box 4.3, 5.5.3, 5.6.5}
- D.6 Sustainable development supports, and often enables, the fundamental societal and systems transitions and transformations that help limit global warming to 1.5°C. Such changes facilitate the pursuit of climate-resilient development pathways that achieve ambitious mitigation and adaptation in conjunction with poverty eradication and efforts to reduce inequalities (*high confidence*). {Box 1.1, 1.4.3, Figure 5.1, 5.5.3, Box 5.3}**
- D.6.1 Social justice and equity are core aspects of climate-resilient development pathways that aim to limit global warming to 1.5°C as they address challenges and inevitable trade-offs, widen opportunities, and ensure that options, visions, and values are deliberated, between and within countries and communities, without making the poor and disadvantaged worse off (*high confidence*). {5.5.2, 5.5.3, Box 5.3, Figure 5.1, Figure 5.6, Cross-Chapter Boxes 12 and 13 in Chapter 5}
- D.6.2 The potential for climate-resilient development pathways differs between and within regions and nations, due to different development contexts and systemic vulnerabilities (*very high confidence*). Efforts along such pathways to date have been limited (*medium confidence*) and enhanced efforts would involve strengthened and timely action from all countries and non-state actors (*high confidence*). {5.5.1, 5.5.3, Figure 5.1}
- D.6.3 Pathways that are consistent with sustainable development show fewer mitigation and adaptation challenges and are associated with lower mitigation costs. The large majority of modelling studies could not construct pathways characterized by lack of international cooperation, inequality and poverty that were able to limit global warming to 1.5°C. (*high confidence*) {2.3.1, 2.5.1, 2.5.3, 5.5.2}

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3

Attachment 1

Summary for Policymakers

SPM

- D.7 Strengthening the capacities for climate action of national and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support the implementation of ambitious actions implied by limiting global warming to 1.5°C (*high confidence*). International cooperation can provide an enabling environment for this to be achieved in all countries and for all people, in the context of sustainable development. International cooperation is a critical enabler for developing countries and vulnerable regions (*high confidence*). {1.4, 2.3, 2.5, 4.2, 4.4, 4.5, 5.3, 5.4, 5.5, 5.6, 5, Box 4.1, Box 4.2, Box 4.7, Box 5.3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 13 in Chapter 5}**
- D.7.1 Partnerships involving non-state public and private actors, institutional investors, the banking system, civil society and scientific institutions would facilitate actions and responses consistent with limiting global warming to 1.5°C (*very high confidence*). {1.4, 4.4.1, 4.2.2, 4.4.3, 4.4.5, 4.5.3, 5.4.1, 5.6.2, Box 5.3}.
- D.7.2 Cooperation on strengthened accountable multilevel governance that includes non-state actors such as industry, civil society and scientific institutions, coordinated sectoral and cross-sectoral policies at various governance levels, gender-sensitive policies, finance including innovative financing, and cooperation on technology development and transfer can ensure participation, transparency, capacity building and learning among different players (*high confidence*). {2.5.1, 2.5.2, 4.2.2, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5, 4.5.3, Cross-Chapter Box 9 in Chapter 4, 5.3.1, 5.5.3, Cross-Chapter Box 13 in Chapter 5, 5.6.1, 5.6.3}
- D.7.3 International cooperation is a critical enabler for developing countries and vulnerable regions to strengthen their action for the implementation of 1.5°C-consistent climate responses, including through enhancing access to finance and technology and enhancing domestic capacities, taking into account national and local circumstances and needs (*high confidence*). {2.3.1, 2.5.1, 4.4.1, 4.4.2, 4.4.4, 4.4.5, 5.4.1, 5.5.3, 5.6.1, Box 4.1, Box 4.2, Box 4.7}.
- D.7.4 Collective efforts at all levels, in ways that reflect different circumstances and capabilities, in the pursuit of limiting global warming to 1.5°C, taking into account equity as well as effectiveness, can facilitate strengthening the global response to climate change, achieving sustainable development and eradicating poverty (*high confidence*). {1.4.2, 2.3.1, 2.5.1, 2.5.2, 2.5.3, 4.2.2, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5, 4.5.3, 5.3.1, 5.4.1, 5.5.3, 5.6.1, 5.6.2, 5.6.3}



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 1

Summary for Policymakers

SPM

## Box SPM.1: Core Concepts Central to this Special Report

**Global mean surface temperature (GMST):** Estimated global average of near-surface air temperatures over land and sea ice, and sea surface temperatures over ice-free ocean regions, with changes normally expressed as departures from a value over a specified reference period. When estimating changes in GMST, near-surface air temperature over both land and oceans are also used.<sup>19</sup> {1.2.1.1}

**Pre-industrial:** The multi-century period prior to the onset of large-scale industrial activity around 1750. The reference period 1850–1900 is used to approximate pre-industrial GMST. {1.2.1.2}

**Global warming:** The estimated increase in GMST averaged over a 30-year period, or the 30-year period centred on a particular year or decade, expressed relative to pre-industrial levels unless otherwise specified. For 30-year periods that span past and future years, the current multi-decadal warming trend is assumed to continue. {1.2.1}

**Net zero CO<sub>2</sub> emissions:** Net zero carbon dioxide (CO<sub>2</sub>) emissions are achieved when anthropogenic CO<sub>2</sub> emissions are balanced globally by anthropogenic CO<sub>2</sub> removals over a specified period.

**Carbon dioxide removal (CDR):** Anthropogenic activities removing CO<sub>2</sub> from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO<sub>2</sub> uptake not directly caused by human activities.

**Total carbon budget:** Estimated cumulative net global anthropogenic CO<sub>2</sub> emissions from the pre-industrial period to the time that anthropogenic CO<sub>2</sub> emissions reach net zero that would result, at some probability, in limiting global warming to a given level, accounting for the impact of other anthropogenic emissions. {2.2.2}

**Remaining carbon budget:** Estimated cumulative net global anthropogenic CO<sub>2</sub> emissions from a given start date to the time that anthropogenic CO<sub>2</sub> emissions reach net zero that would result, at some probability, in limiting global warming to a given level, accounting for the impact of other anthropogenic emissions. {2.2.2}

**Temperature overshoot:** The temporary exceedance of a specified level of global warming.

**Emission pathways:** In this Summary for Policymakers, the modelled trajectories of global anthropogenic emissions over the 21st century are termed emission pathways. Emission pathways are classified by their temperature trajectory over the 21st century: pathways giving at least 50% probability based on current knowledge of limiting global warming to below 1.5°C are classified as 'no overshoot'; those limiting warming to below 1.6°C and returning to 1.5°C by 2100 are classified as '1.5°C limited-overshoot'; while those exceeding 1.6°C but still returning to 1.5°C by 2100 are classified as 'higher-overshoot'.

**Impacts:** Effects of climate change on human and natural systems. Impacts can have beneficial or adverse outcomes for livelihoods, health and well-being, ecosystems and species, services, infrastructure, and economic, social and cultural assets.

**Risk:** The potential for adverse consequences from a climate-related hazard for human and natural systems, resulting from the interactions between the hazard and the vulnerability and exposure of the affected system. Risk integrates the likelihood of exposure to a hazard and the magnitude of its impact. Risk also can describe the potential for adverse consequences of adaptation or mitigation responses to climate change.

**Climate-resilient development pathways (CRDPs):** Trajectories that strengthen sustainable development at multiple scales and efforts to eradicate poverty through equitable societal and systems transitions and transformations while reducing the threat of climate change through ambitious mitigation, adaptation and climate resilience.

<sup>19</sup> Past IPCC reports, reflecting the literature, have used a variety of approximately equivalent metrics of GMST change.



# CLIMATE JUSTICE ALLIANCE

## Just Transition Principles

*This short paper aims to articulate the shared analysis & principles held by members of the Climate Justice Alliance, recognizing that a Just Transition will look different in different places.<sup>1</sup>*

### What Do We Mean By Just Transition?

*"Just Transition is a principle, a process and a practice."*  
— Just Transition Alliance

Just Transition is a vision-led, unifying and place-based set of principles, processes and practices that build economic and political power to shift from an extractive economy<sup>2</sup> to a regenerative economy. This means approaching production and consumption cycles holistically and waste free. The transition itself must be just and equitable; redressing past harms and creating new relationships of power for the future through reparations. If the process of transition is not just, the outcome will never be. Just Transition describes both where we are going and how we get there.

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 2

## History & Context

Just Transition strategies were first forged by labor unions and environmental justice groups, rooted in low-income communities of color, who saw the need to phase out the industries that were harming workers, community health and the planet; and at the same time provide just pathways for workers to transition to other jobs. It was rooted in workers defining a transition away from polluting industries in alliance with fence line and frontline communities.

The environmental justice (EJ) movement grew out of a response to the system of environmental racism where communities of color and low-income communities have been (and continue to be) disproportionately exposed to and negatively impacted by hazardous pollution and industrial practices. Its roots are in the civil rights movement, and are in sharp contrast to the mainstream environmental movement, which has failed to understand or address this injustice<sup>3</sup>. The EJ movement emphasizes bottom up organizing, centering the voices of those most impacted, and shared community leadership.

Building on these histories, members of the Climate Justice Alliance, many of whom are rooted in the environmental justice movement, have adapted the definition of Just Transition to represent a host of strategies to *transition whole communities*<sup>4</sup> to build thriving economies that provide dignified, productive and ecologically sustainable livelihoods; democratic governance and ecological resilience.

### Some of the movement leaders who have built a strong foundation for just transition



Connie Tucker, Southern Organizing Committee for Economic & Social Justice



Jose Bravo, Just Transition Alliance



Pam Tau Lee, Chinese Progressive Association



Richard Moore, Southwest Network for Environmental and Economic Justice and Los Jardines Institute



Tom Goldtooth, Indigenous Environmental Network



Tony Mazzocchi, Oil, Chemical & Atomic Workers International Union

# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

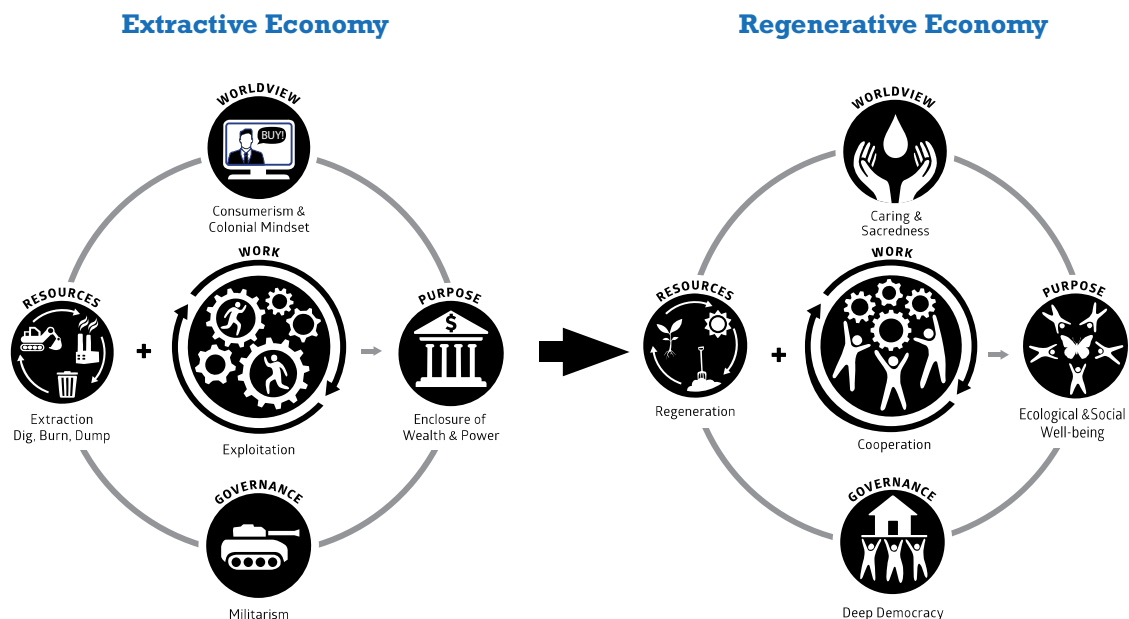
Item 9.3  
Attachment 2

## Analysis, Framework and Strategy

After centuries of global plunder, the profit-driven industrial economy rooted in patriarchy and white supremacy is severely undermining the life support systems of the planet. Transition is inevitable. Justice is not.

We must build visionary economy that is very different than the one we now are in. This requires stopping the bad while at the same time as building the new. We must change the rules to redistribute resources and power to local communities. Just transition initiatives are shifting from dirty energy to energy democracy, from funding highways to expanding public transit, from incinerators and landfills to zero waste, from industrial food systems to food sovereignty, from gentrification to community land rights, from military violence to peaceful resolution, and from rampant destructive development to ecosystem restoration. Core to a just transition is deep democracy in which workers and communities have control over the decisions that affect their daily lives.

To liberate the soil and to liberate our souls we must decolonize our imaginations, remember our way forward and divorce ourselves from the comforts of empire. We must trust that deep in our cultures and ancestries is the diverse wisdom we need to navigate our way towards a world where we live in just relationships with each other and with the earth.





# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 2

## CJA Just Transition Principles

*There are existing principles, including the Principles of Environmental Justice and Jemez Principles for Democratic Organizing, that have been important in guiding our work. The Just Transition principles below are an attempt to consolidate and synthesize various Just Transition principles from among CJA members and allies, built off the deep work and discussions amongst ourselves. Understanding that Just Transition will look different in different places, we believe a core set of shared principles can strengthen our collective work.*

### **A Just Transition moves us toward Buen Vivir**

Buen Vivir means that we can *live well* without *living better* at the expense of others. Workers, community residents, women and Indigenous Peoples around the world have a fundamental human right to clean, healthy and adequate air, water, land, food, education and shelter. We must have just relationships with each other and with the natural world, of which we are a part. The rights of peoples, communities and nature must supercede the rights of the individual.

### **A Just Transition creates Meaningful Work**

A Just Transition centers on the development of human potential, creating opportunities for people to learn, grow, and develop to their full capacities and interests. We are all born leaders, and a regenerative economy supports and nurtures that leadership. In the process, we are transforming ourselves, each other, our communities, and our society as a whole. Meaningful work is life-affirming.

### **A Just Transition upholds Self Determination**

All peoples have the right to participate in decisions that impact their lives. This requires democratic governance in our communities, including our workplaces. Communities must have the power to shape their economies, as producers, as consumers, and in our relationships with each other. Not only do we have the right to self determination, but self determination is one of our greatest tools to realize the world we need. The people who are most affected by the extractive economy — the frontline workers and the fenceline communities — have the resilience and expertise to be in the leadership of crafting solutions.



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 2

## **A Just Transition equitably redistributes Resources and Power**

We must work to build new systems that are good for all people, and not just a few. Just Transition must actively work against and transform current and historic social inequities based on race, class, gender, immigrant status and other forms of oppression. Just Transition fights to reclaim capital and resources for the regeneration of geographies and sectors of the economy where these inequities are most pervasive.

## **A Just Transition requires Regenerative Ecological Economics**

Just Transition must advance ecological resilience, reduce resource consumption, restore biodiversity and traditional ways of life, and undermine extractive economies, including capitalism, that erode the ecological basis of our collective well-being. This requires a re-localization and democratization of primary production and consumption by building up local food systems, local clean energy, and small-scale production that are sustainable economically and ecologically. This also means producing to *live well* without *living better* at the expense of others.

## **A Just Transition retains Culture and Tradition**

Capitalism has forced many communities to sacrifice culture and tradition for economic survival. It has also defaced and destroyed land held as sacred. Just Transition must create inclusionary spaces for all traditions and cultures, recognizing them as integral to a healthy and vibrant economy. It should also make reparations for land that has been stolen and/or destroyed by capitalism, colonialism, patriarchy, genocide and slavery.

## **A Just Transition embodies Local, Regional, National and International Solidarity**

A Just Transition must be liberatory and transformative. The impacts of the extractive economy knows no borders. We recognize the interconnectedness of our communities as well as our issues. Therefore, our solutions call for local, regional, national and global solidarity that confronts imperialism and militarism.

## **A Just Transition builds What We Need Now**

We must build the world we need now. This may begin at a local small scale, and must expand to begin to displace extractive practices. We must build and flex the muscles needed to meet our communities' needs.



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 2

## What Just Transition is NOT: Avoiding False Solutions

We understand that as frontline communities, we are often faced with navigating many contradictions. We have seen that the fight against climate change has now become a big business opportunity. In this context, it is important to recognize approaches that will only worsen our ecological and economic crises. We call these 'false solutions.' The following definitions of false solutions offer a political compass for our movements, knowing that we will engage more deeply in the nuances of various solutions in front of us in our regional and organizational contexts.



### **False Solutions extract & further concentrate wealth and political power**

Carbon trading and other market-based incentives are presented as “economically and politically viable” strategies to address the climate crisis. Unfortunately, this makes the false and dangerous assumption that the laws of nature are subordinate to the laws of capitalism. These undemocratic mechanisms prioritize maximizing profit for those at the top at the expense of the earth and people. These do not move us toward a just transition.

### **False Solutions continue to poison, displace, and imprison communities**

Nuclear, fracking, “clean coal”, incineration and even prisons are offered as economic transition solutions to the climate crisis, but only continue to harm the health of people and the planet. The path of extracting, transporting, processing, and consuming these technologies is paved with communities riddled with cancer, reproductive and respiratory disease, among other devastating health impacts. These false solutions turn low-income communities, communities of color and indigenous communities into sacrifice zones. These do not move us toward a just transition.

### **False Solutions reduce the climate crisis to a crisis of carbon**

The climate ‘crisis’ is a symptom of a deeper crisis: resource intensive industrial production of the dominant dig, burn, dump economy. Addressing only carbon emissions without challenging the growth-at-all-costs economy doesn’t resolve the real crisis. This is not to say that carbon doesn’t matter, but it is not the only thing that matters. Techno-fixes like titanium oxide cloud seeding or injecting carbon into the sea bottom are solutions for making money off of the climate crisis more than they are solutions to the climate crisis. It is unclear that these technologies will even work. It is highly likely that they’ll have unintended consequences. These efforts avoid the real solutions of reducing pollution at the source. These do not move us toward a just transition.



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 2



## **Solving the Climate Crisis: It is possible. It is necessary. There are no shortcuts.**

There's no silver bullet. As we know, it will look different in different places. And let's remember: Transition is inevitable. Justice is not. Let's get to work.

## **Endnotes**

1. The drafting process involved consolidating various principles developed by CJA member organizations -- Just Transition Alliance, Kentuckians for the Commonwealth, and Movement Generation -- and discussions by CJA pilot site anchor organizations. CJA staff developed a first draft and got feedback from CJA member organizations at the Growing Our Power national convening in St. Louis and through online comments. A drafting team made up of CJA members and staff, with additional input from the Steering Committee and Pilot Site reps, finalized this working draft.
2. By extractive economy, we mean an economy that relies on the extraction of labor, of natural resources, of culture and of community.
3. Robert D. Bullard, *Dumping in Dixie: Race, Class, and Environmental Quality* (Westview Press, 2000).
4. By whole communities, we mean to include workplaces, homes, schools, implying that we are workers, we are community members, we are whole people.



# Considered at June 11, 2019 Regular Council Meeting

RC - Agenda - 2019 06 11

Item 9.3  
Attachment 2



## CLIMATE JUSTICE ALLIANCE

[www.ourpowercampaign.org](http://www.ourpowercampaign.org)



### Acknowledgements

*CJA would like to acknowledge and show appreciation for the work and leadership of the Just Transition Alliance, the CJA Steering Committee, the CJA Pilot Site organizations, and of the drafting team: brandon king of Cooperation Jackson, Sara Pennington of Kentuckians for the Commonwealth, Mateo Nube of Movement Generation and Hannah Jones of the Center for Story-based Strategy.*

Design Action Collective