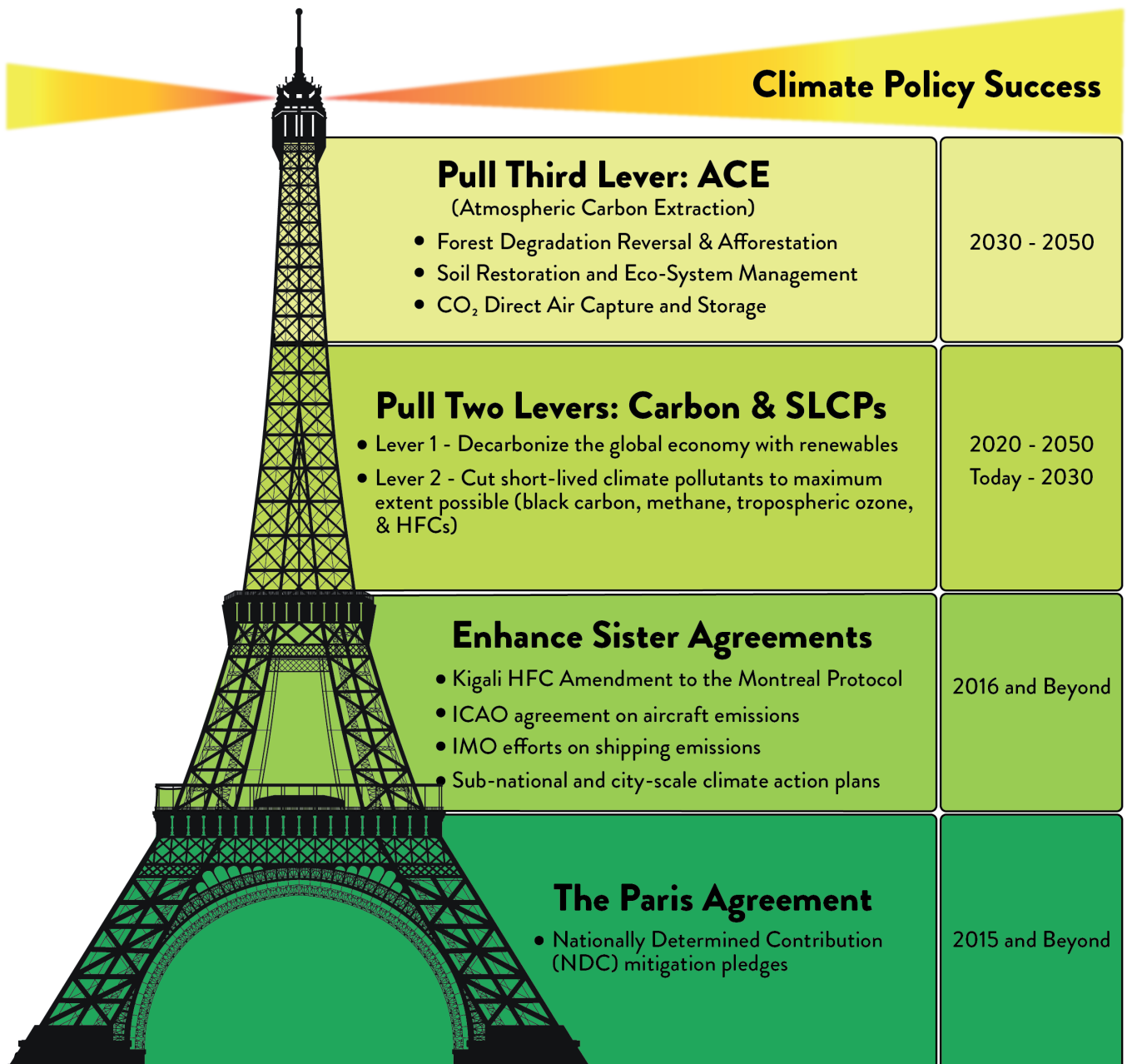


# Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Changes

Report from the Committee to Prevent Extreme Climate Change  
Chairs: V. Ramanathan, M. J. Molina and D. Zaelke

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## High Level Summary

The Paris Agreement is an historic achievement. For the first time, effectively all nations have committed to limit their greenhouse gas emissions and take other actions to limit and adapt to climate change to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels and pursu[e] efforts to limit the temperature increase to 1.5°C above pre-industrial levels.” But the Agreement and supporting climate policies must be strengthened substantially within the next five years to prevent catastrophic warming. Until now, no specific plan or policy roadmap has been proposed to provide a realistic and reasonable chance of limiting global temperatures to safe levels and preventing unmanageable climate change. This report provides such a plan—an outline of specific solutions that serve as the building blocks for a three-level strategy to limit warming to under 2°C and thus avoid extreme and unmanageable climate changes.

The first building block would be fully implementing the nationally determined mitigation pledges under the Paris Agreement of the UNFCCC. The next building blocks would be strengthening sister agreements and numerous sub-national and city scale climate action plans which can provide targeted and efficient mitigation. Sister agreements include the HFCs Kigali Amendment to the Montreal Protocol, the European F-gas rule, other HFC measures at national levels, and the HFC commitments under the Paris Agreement. These HFCs measures can avoid as much as 0.5°C of warming by 2100 through the global phasedown of HFCs within few decades. Other promising examples include California’s Under 2 MOU signed by over 136 jurisdictions representing 32 countries and six continents and climate action plans by over 52 cities and 65 businesses around the world aiming to become carbon neutral. There are concerns that the carbon neutral goal will hinder economic progress; however, real world examples from California and Sweden since 2005 prove that economic growth can be decoupled from carbon emissions.

The third building blocks consist of pulling on two levers as hard as we can: one for drastically reducing emissions of short-lived climate pollutants (SLCPs) beginning now and completing by 2030, and the other for decarbonizing the global economy by 2050. Pulling both levers simultaneously can keep global temperature rise below 2°C through the end of the century. If we bend the CO<sub>2</sub> emissions curve such that global emissions peak in 2020 and begin to decrease thereafter, there is less than a 20% probability of exceeding 2°C. This call for bending the CO<sub>2</sub> curve beginning in 2020 is one major new proposal of this report. Many cities and jurisdictions are already on this pathway thus demonstrating its scalability.

For the final building block, we are adding a third lever, ACE (Atmospheric Carbon Extraction, also commonly know as Carbon Dioxide Removal, or “CDR”). This lever is added as an insurance against surprises (due to policy lapses, mitigation delays or non-linear climate changes) and requires development of scalable measures for removing the CO<sub>2</sub> already in the atmosphere. The amount of CO<sub>2</sub> that has to be removed will range from negligible, if the emissions of CO<sub>2</sub> and SLCPs start to decrease by 2020 and carbon neutrality is achieved by 2050, to a staggering one trillion tons, if CO<sub>2</sub> emissions continue

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to increase until 2030, and the carbon lever is pulled after 2030. This issue is raised because the NDCs (Nationally Determined Contributions) accompanying the Paris Agreement would allow CO<sub>2</sub> emissions to increase until 2030. We call on economists to assess the cost-effectiveness of reducing carbon and SLCPs emissions beginning in 2020 compared with delaying it by ten years and then being forced to pull the third lever to extract one trillion tons of CO<sub>2</sub>.

The fast mitigation plan of requiring emissions reductions to begin by 2020 is urgently needed to limit the warming to under 2°C. Climate change is not a linear problem. Instead, we are facing non-linear climate tipping points that can lead to self-reinforcing and cascading climate change impacts. Tipping points are more likely with increased temperatures, and many of the potential abrupt climate shifts could happen as warming goes from 1.5°C to 2°C, with the potential to push us well beyond the Paris goals.

[Where Do We Go from Here?](#) We have almost run out of time to address these concerns. We must act now, and we must act fast. This report sets out a specific plan for reducing climate change in both the near- and long-term. With aggressive, urgent actions that begin by 2020, we can protect ourselves. Acting quickly to prevent catastrophic climate change by decarbonization will save millions of lives, trillions of dollars in economic costs, and massive suffering and dislocation to people around the world. This is a global security imperative, as it can avoid the migration and destabilization of entire societies and countries and reduce the likelihood of environmentally driven civil wars and other conflicts.

Staying at under 2°C will require a concerted global effort. We must address everything from our energy systems to our personal choices to reduce emissions to the greatest extent possible. The health of people for generations to come and the health of ecosystems crucially depend on an energy revolution beginning now that will take us away from fossil fuels and toward the renewable energy sources of the future beginning now. This is our future, and we must transition to that clean energy future quickly. Towards this vision we are articulating:

## [10 Scalable Solutions for Implementing Climate Stability Building Blocks](#)

Achieving success will require the global mobilization of human, financial, and technical resources. For the global economy and society to achieve such rapid reductions in SLCPs by 2030 and carbon neutrality and climate stability by 2050, we will need multi-dimensional and multi-sectoral changes and modifications, which are grouped under Ten Scalable Solutions in the table below. We have adapted the solutions from the report: *Bending the Curve\** written by fifty researchers from the University of California system. These solutions, which often overlap, were in turn distilled from numerous publications and reports.

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### *Science Solutions*

1. Show that we can bend the warming curve immediately by reducing SLCPs, and long-term by replacing current fossil fuel energy systems with carbon neutral technologies.

### *Societal Transformation Solutions*

2. Foster a global culture of climate action through coordinated public communication and education at local to global scales.

3. Build an alliance between science, religion, health care, and policy to change behavior and garner public support for drastic mitigation actions.

### *Governance Solutions*

4. Build upon and strengthen the Paris Agreement. Strengthen sister agreements like the Montreal Protocol's Kigali Amendment to reduce HFCs.

5. Scale up subnational models of governance and collaboration around the world to embolden and energize national and international action. California's Under 2 MOU and climate action plans by over 50 cities are prime examples.

### *Market- and Regulations-Based Solutions*

6. Adopt market-based instruments to create efficient incentives for businesses and individuals to reduce CO<sub>2</sub> emissions.

7. Target direct regulatory measures—such as rebates and efficiency and renewable energy portfolio standards—for high emissions sectors not covered by market-based policies.

### *Technology-Based Solutions*

8. Promote immediate widespread use of mature technologies such as photovoltaics, wind turbines, biogas, geothermal, batteries, hydrogen fuel cells, electric light-duty vehicles, and more efficient end-use devices, especially in lighting, air conditioning and other appliances, and industrial processes. Aggressively support and promote innovations to accelerate the complete electrification of energy and transportation systems and improve building efficiency.

9. Immediately make maximum use of available technologies combined with regulations to reduce methane emissions by 50%, reduce black carbon emissions by 90%, and eliminate high-GWP HFCs ahead of the schedule in the Kigali Amendment.

### *Atmospheric Carbon Extraction Solutions*

10. Regenerate damaged natural ecosystems and restore soil organic carbon.; Expand with urgency research and development of approaches and measures for direct extraction of CO<sub>2</sub>.

\* Adapted from Ramanathan et al (2015) and modified by authors of this report.

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## The Committee to Prevent Extreme Climate Change (CPECC)

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