

Non-CO₂ – Fast Climate Solutions to Slow Warming in the Near Term

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EESI Congressional Climate Camp
23 February 2023



Strategies Targeting Non-CO₂



Slow warming in the next 20 years

Cutting SLCPs could avoid 4X more warming in 2050 than decarbonization alone



Improve health

Black carbon and ozone (including from methane) are major air pollutants; avoid millions of premature deaths



Increase food security

Avoid billions in dollars in crop losses from ozone and heat damage; cut N₂O with precision agriculture



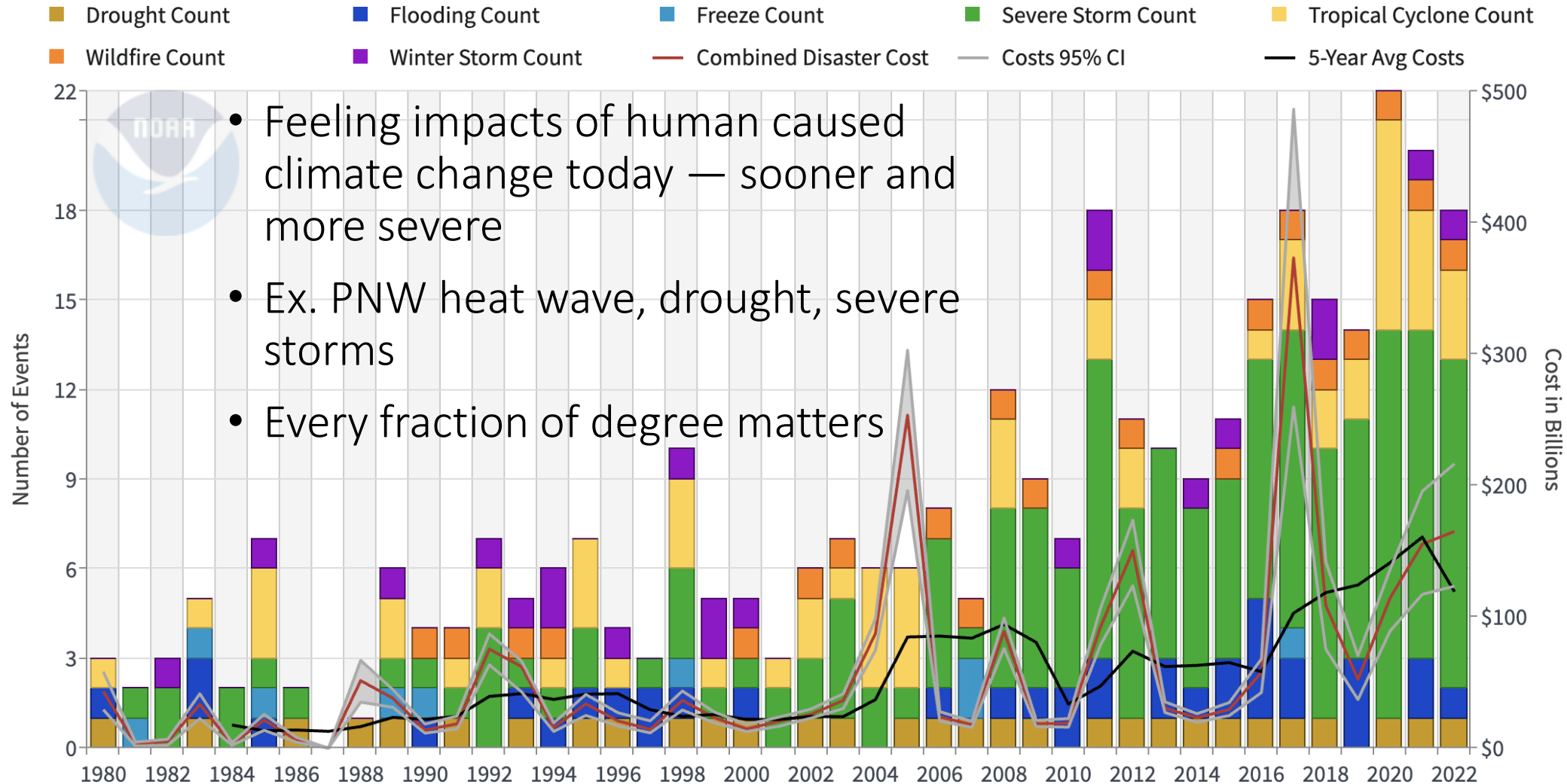
Avoid energy waste

Fix leaks and capture emissions that waste 110 million metric tons of methane every year

	Potency over 20 years	Potency over 100 years	Lifetime	Impacts	
Long-lived Greenhouse Gases (GHG)	Carbon dioxide (CO ₂)	1	1	100 – 1000s years	Long-term warming Ocean acidification
	Nitrous oxide (N ₂ O)	273	273	109 years	Long-term warming Ozone-depleting
Super Climate Pollutants	Methane (CH ₄)	81	28	11.8 years	Near-term warming Ground-level ozone
	Hydrofluorocarbons (HFCs)	1 – 12,400	1 – 14,600	15 years (average)	Near-term warming
Short-lived Climate Pollutants (SLCP)	Ground-level ozone (O ₃)	<i>Not directly emitted</i>		weeks	Criteria pollutant
	Black carbon	2400*	660*	days	Criteria pollutant (constituent of PM _{2.5})

Climate Change Impacts Today

United States Billion-Dollar Disaster Events 1980-2022 (CPI-Adjusted)



- Feeling impacts of human caused climate change today — sooner and more severe
- Ex. PNW heat wave, drought, severe storms
- Every fraction of degree matters

Short-lived climate pollutants (methane, HFCs, black carbon, ozone) contribute half of total warming

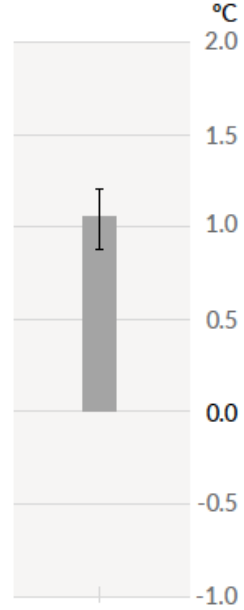
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IPCC AR6 WGI Figure SPM.2

Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling

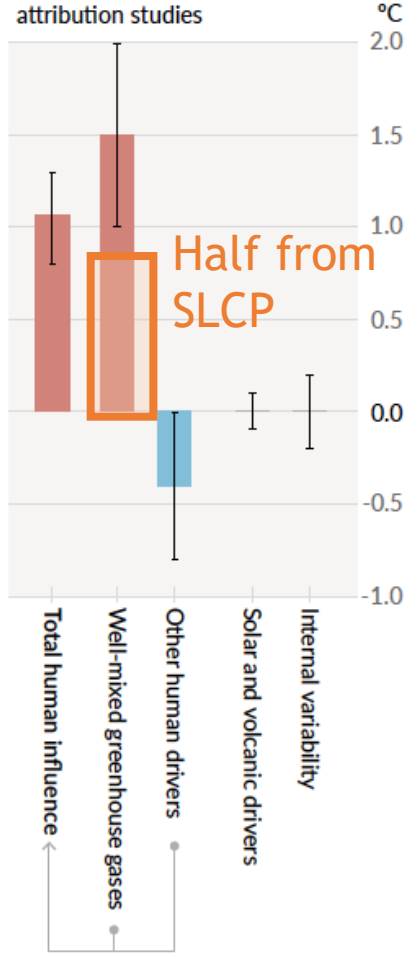
Observed warming

a) Observed warming 2010-2019 relative to 1850-1900

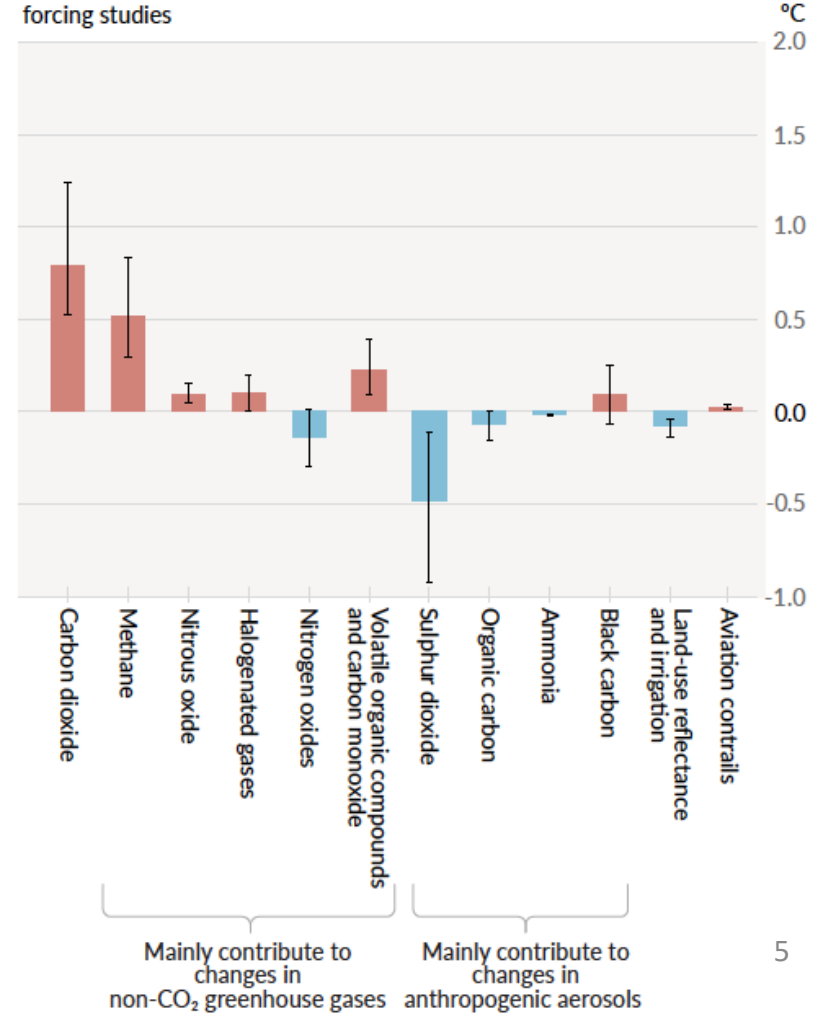


Contributions to warming based on two complementary approaches

b) Aggregated contributions to 2010-2019 warming relative to 1850-1900, assessed from attribution studies



c) Contributions to 2010-2019 warming relative to 1850-1900, assessed from radiative forcing studies



SLCP Climate Benefits

Avoided global warming

Rapid implementation of SLCP mitigation measures, together with measures to reduce CO₂ emissions, would greatly improve the chances of keeping the Earth's temperature increase to less than 2°C relative to pre-industrial levels.

Dual strategy

combine SLCP *sprint* with CO₂ *marathon*

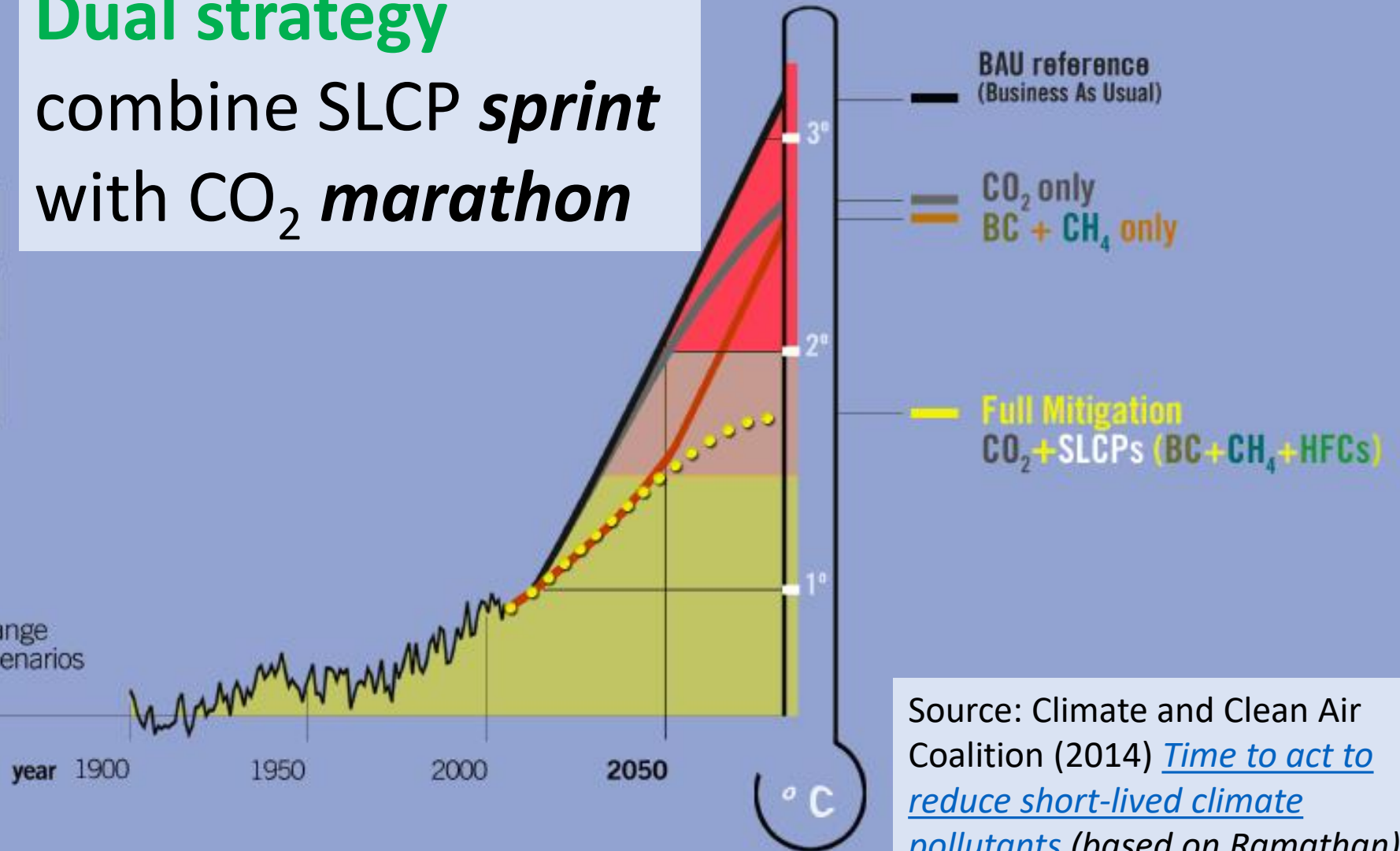
AVOIDED GLOBAL WARMING by 2050

BC + CH₄ 0.5°C

HFCs 0.1°C

SLCPs 0.6°C

Simulated temperature change under various mitigation scenarios
CO₂, BC, CH₄, HFCs



Source: Climate and Clean Air Coalition (2014) [Time to act to reduce short-lived climate pollutants](#) (based on Ramathan)

Montreal Protocol – Benefits Extend Beyond Fixing the Ozone Hole

- Ozone hole is recovering thanks to compliance with 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and amendments phasing out HCFCs.
- Avoided 0.5–1.0°C of warming by 2050 by stopping build-up of potent CFCs, HCFCs, Halons; protecting terrestrial plants and carbon sink from UV will avoid up to an additional 1.0°C by 2100.
- Avoided hundreds of millions of cases of skin cancer and cataracts.
- 2016 Kigali Amendment phases down production and use of HFCs; ratified by Senate in September 2022; EPA currently implementing American Innovation and Manufacturing (AIM) Act of 2020.

Implementing the 2016 Kigali Amendment and aggressively phasing down HFCs will avoid 0.1 °C by 2050

Even more with energy efficiency

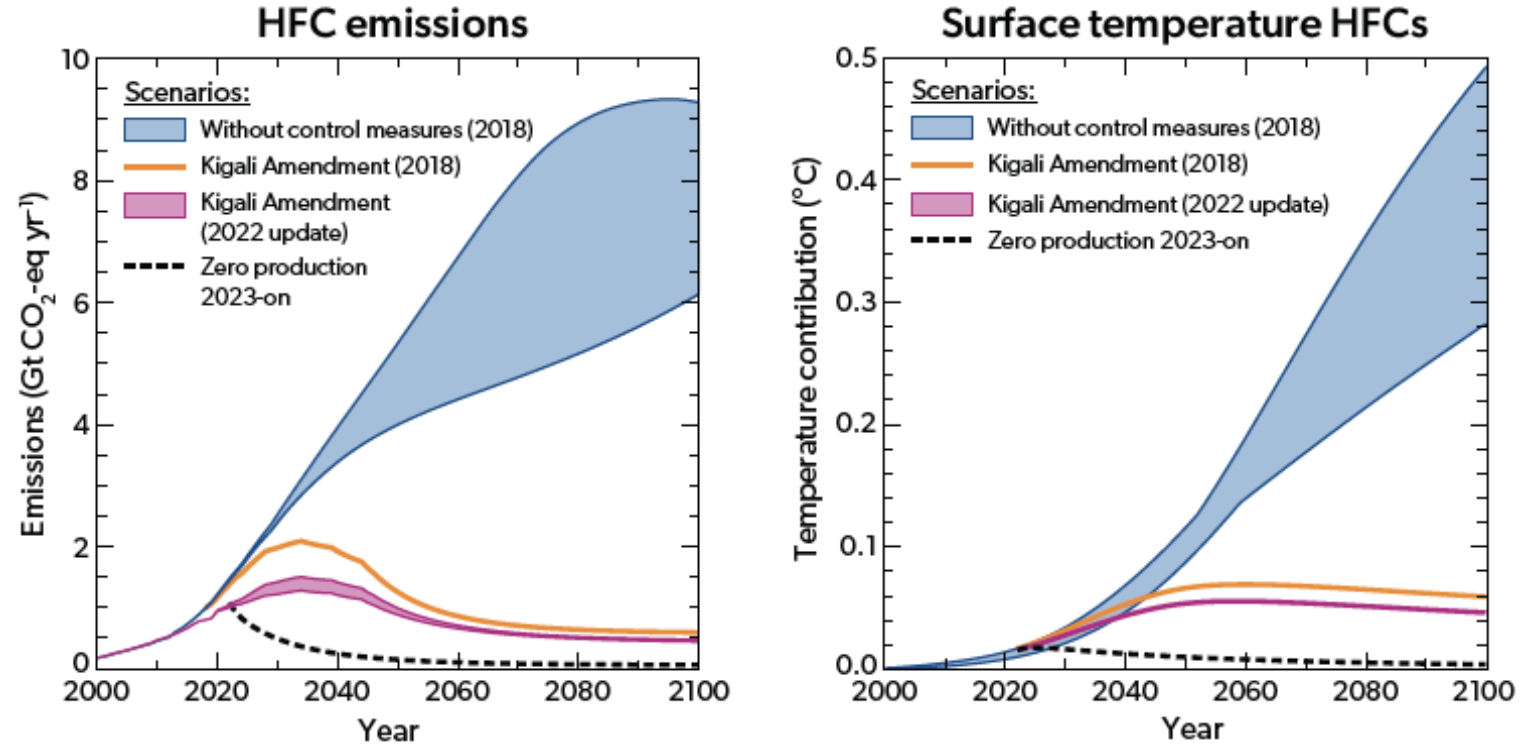
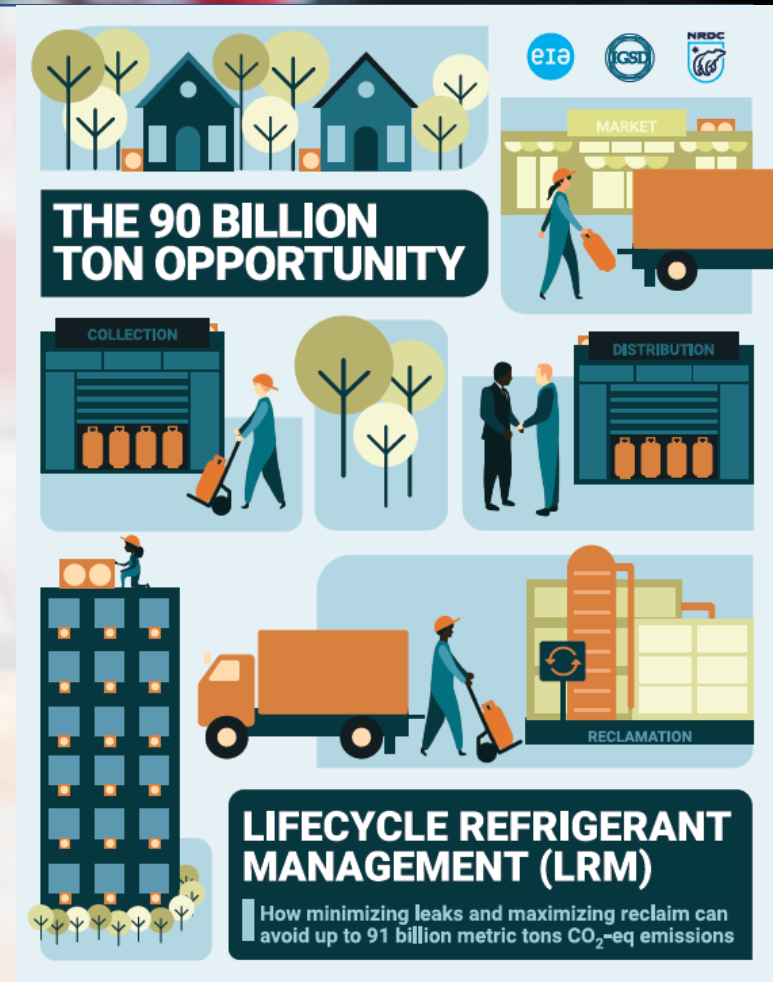


Figure ES-4. HFC emissions (left) and their impact on global average surface temperature (right). Shown is a scenario without global HFC control measures (the 'baseline' scenario from the 2018 Assessment, blue area) and the 2018 and 2022 scenarios assuming full compliance with the Kigali Amendment (orange and pink, respectively). Also shown is a scenario assuming that the global production of HFCs ceased in 2020 (black dashed line). For comparison, the total warming from all greenhouse gases is projected to be 1.4 °C to 4.4 °C by the end of the 21st century, relative to 1850–1900, following IPCC (2021) projections. The contribution from HFC-23 emissions is not included here.

Lifecycle Refrigerant Management

- Roughly 100 billion metric tons CO₂e avoidable emissions this century (*additional* to Kigali Amendment)
- Refrigerant and foam banks will continue to grow under the HFC phase-down
- Most emissions are preventable through reducing leaks and end-of-life release
- ~60% consumption for filling existing equipment

ODS & HFC Refrigerants (GtCO ₂ e)	Current	Through 2050	Through 2100
United States	3.6	6.9	9.2
Global	34	61	91



EIA, NRDC, IGSD (2022)

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Resources

- Climate and Clean Air Coalition <https://www.ccacoalition.org/en>
- IGSD (2022) [The Need for Fast Near-Term Climate Mitigation to Slow Feedbacks and Tipping Points.](#)
- IGSD (2023) [A Primer on Cutting Methane: The Best Strategy for Slowing Warming in the Decade to 2030.](#)
- Theodoridi C., Hillbrand A., Starr C., Mahapatra A., & Taddonio K. (2022) [THE 90 BILLION TON OPPORTUNITY: LIFECYCLE REFRIGERANT MANAGEMENT \(LRM\) - HOW MINIMIZING LEAKS AND MAXIMIZING RECLAIM CAN AVOID UP TO 91 BILLION METRIC TONS CO₂-EQ EMISSIONS, EIA, NRDC, IGSD.](#)
- WMO *et al.* (2022) *Executive Summary*, in [SCIENTIFIC ASSESSMENT OF OZONE DEPLETION: 2022](#), Geneva, Switzerland.



Thank you!

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