Integrating Equity in Addressing Global Change

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Center for Sustainability Science and Strategy

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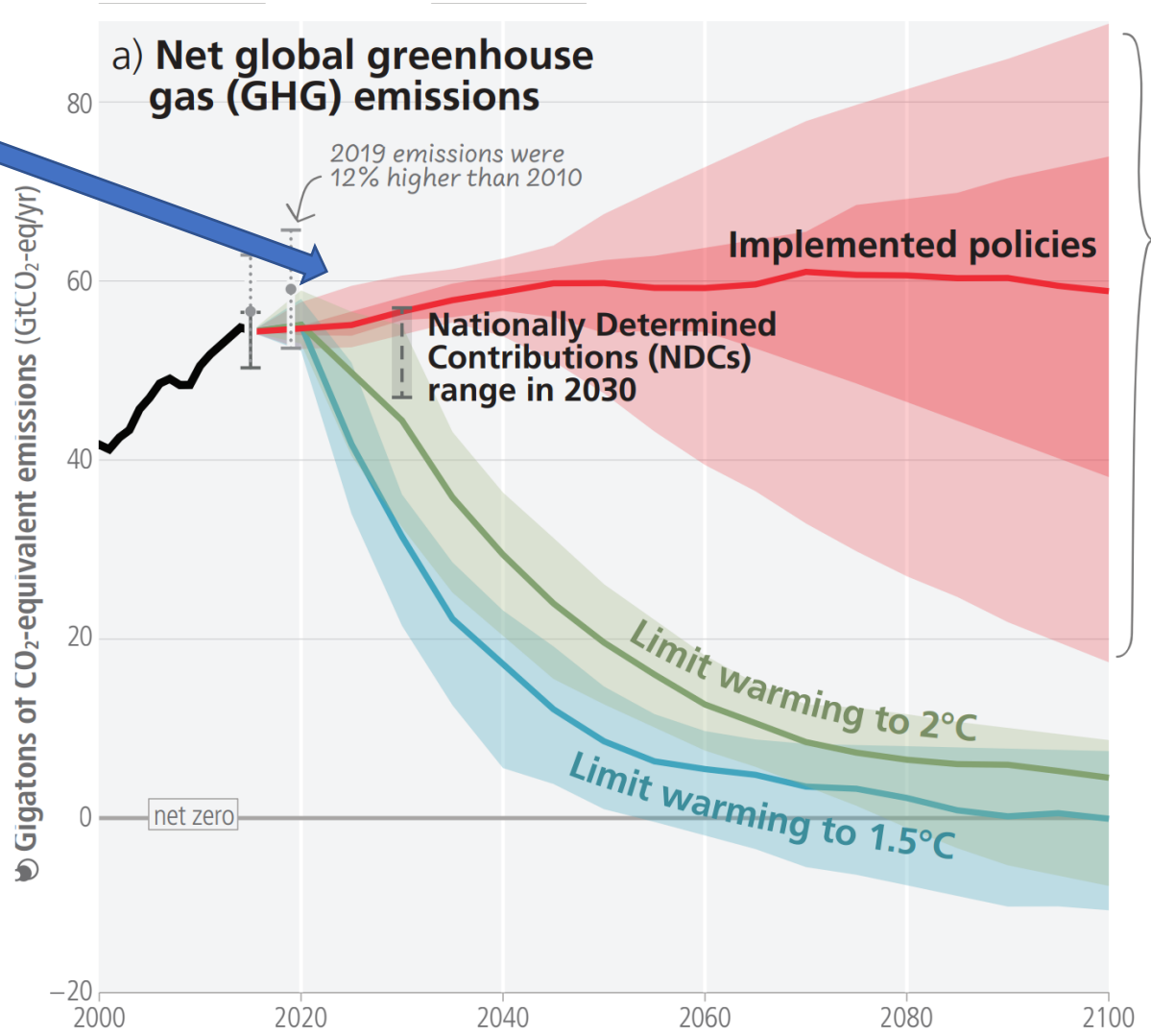
Sustainability Science: Navigating the Challenges of Global Change

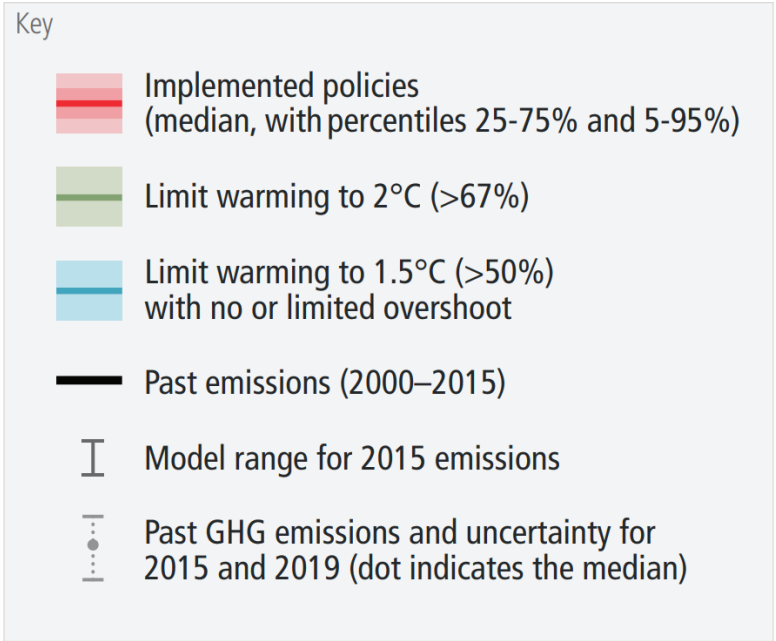
2023 IPCC AR6 Synthesis Report – Global emission pathways

2021 -2024 emissions are outside of the IPCC range



COP-28: "transitioning away from fossil fuels in energy systems, in a just, orderly and equitable manner … "

Implemented policies result in projected emissions that lead to warming of 3.2°C, with a range of 2.2°C to 3.5°C (medium confidence)



COP-28: “transitioning away from fossil fuels in energy systems, in a just, orderly and equitable manner … so as to achieve net zero by 2050 in keeping with the science.”

However, in the literature, there are numerous options for the just and equitable “Fair Share” of emission reduction burden

Cumulative historic emissions

GDP/capita (MER vs PPP)

UNDP Human Development Index

To converge emissions per capita

To reach the same level of cumulative emissions per capita

Equal cost of reduction (e.g., same percent of GDP cost)

Some weighted average of options, etc.

COP-29: Who will pay? How much?

Source: MIT Joint Program Report 167 (2008)

Welfare effects of different burden sharing

	Allocation Rule			Full Compensation	
	30-70	*Pop based*	*GDP based*	*Full comp-equal alloc*	*Full comp-equal cost*
2050					
Annex I					
USA	-2.6	-5.5	-7.2	-7.4	-9.4
CAN	-11.8	-15.6	-16.0	-18.1	-9.4
JPN	-2.6	-3.0	-4.3	-4.5	-9.4
ANZ	-6.3	-10.0	-9.1	-12.5	-9.4
EUR	-5.2	-6.3	-8.6	-8.9	-9.4
EET	-8.5	-11.6	3.4	-25.0	-9.4
FSU	-21.6	-24.5	-22.5	-41.0	-9.4
Non-Annex I					
MEX	-7.4	-11.2	-3.7	**0.0**	**0.0**
ASI	-4.3	-11.0	-14.0	**0.0**	**0.0**
CHN	-0.4	2.2	-7.7	**0.0**	**0.0**
IND	-11.4	21.0	48.9	**0.0**	**0.0**
IDZ	-15.8	-3.7	63.2	**0.0**	**0.0**
AFR	-28.5	-7.5	4.7	**0.0**	**0.0**
MES	-51.7	-61.0	-56.8	**0.0**	**0.0**
LAM	-12.2	-13.2	-20.0	**0.0**	**0.0**
ROW	-9.8	5.1	10.2	**0.0**	**0.0**

Note: Entries in **bold** indicate pre-specified welfare outcomes.

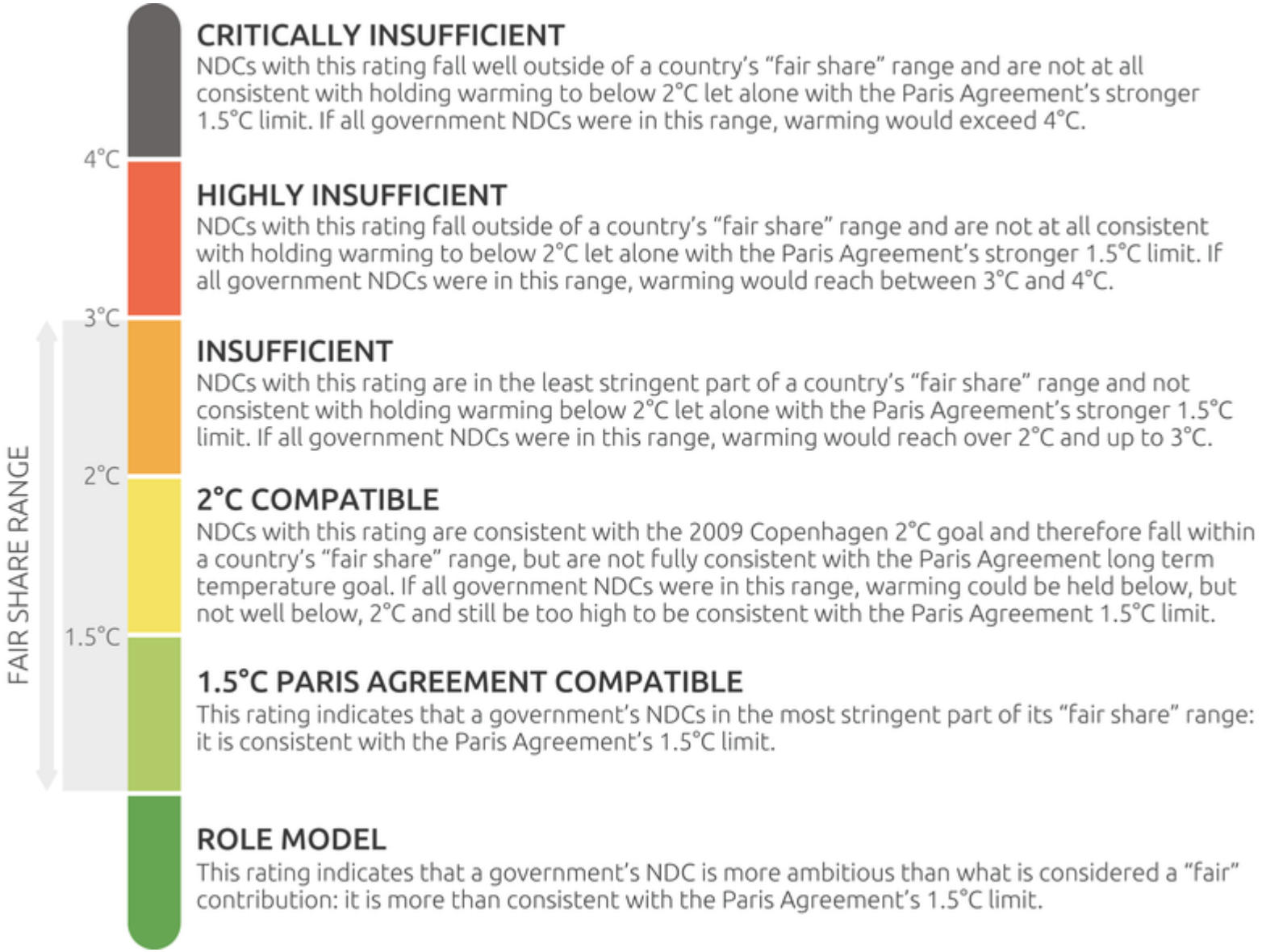
Welfare Effects (% change from reference)

	Allocation Rule			Full Compensation	
	30-70	*Pop based*	*GDP based*	*Full comp-equal alloc*	*Full comp-equal cost*
2050					
Annex I					
USA	-179.6	-668.8	-1024.0	-1239.4	-1715.5
CAN	-35.7	-87.2	-93.6	-148.8	2.1
JPN	-172.8	-187.3	-288.6	-358.6	-942.1
ANZ	-30.1	-72.7	-70.3	-120.5	-78.6
EUR	-195.9	-299.9	-715.6	-866.1	-985.3
EET	-9.1	-15.5	119.4	-146.9	7.1
FSU	-44.2	-58.8	0.8	-434.3	299.9
Non-Annex I					
MEX	31.5	-9.2	66.7	108.4	110.1
ASI	130.5	-131.2	-241.3	355.8	363.8
CHN	484.0	577.1	80.8	589.0	578.3
IND	14.7	513.9	1056.3	176.4	189.5
IDZ	-40.9	32.9	574.1	85.0	91.2
AFR	43.4	373.1	609.7	543.0	558.7
MES	77.4	-15.4	51.1	761.1	797.3
LAM	-81.9	-158.6	-428.3	536.8	556.7
ROW	8.6	207.6	302.9	159.1	167.0
AnxI net	667.3	1390.3	2071.9	3314.6	3412.5

Net financial transfers (billion US dollars)

Welfare costs can be both substantial and wildly different across regions depending on the allocation method chosen. Implied financial transfers are large—over $400 billion per year in 2020 and rising to around $3 trillion in 2050.

Another example of “fair share range”: Climate Action Tracker



https://climateactiontracker.org/methodology/comparability-of-effort/

US Regional Policy Model (USREP) Example: Distributional Impacts

https://www.youtube.com/watch?v=-cdy1-bC9lk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Toward a just energy transition: A distributional analysis of low-carbon policies in the USA

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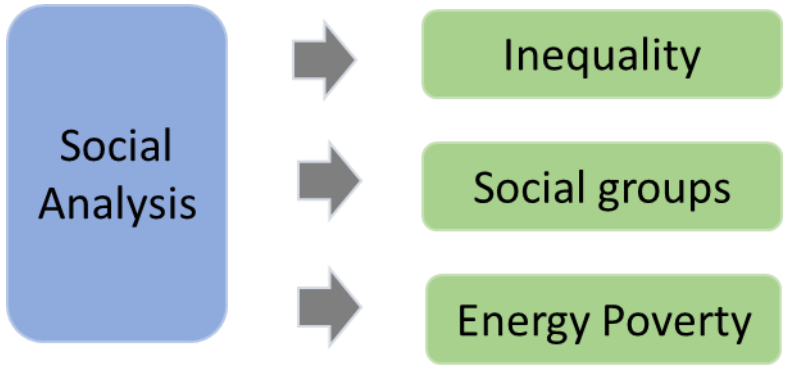
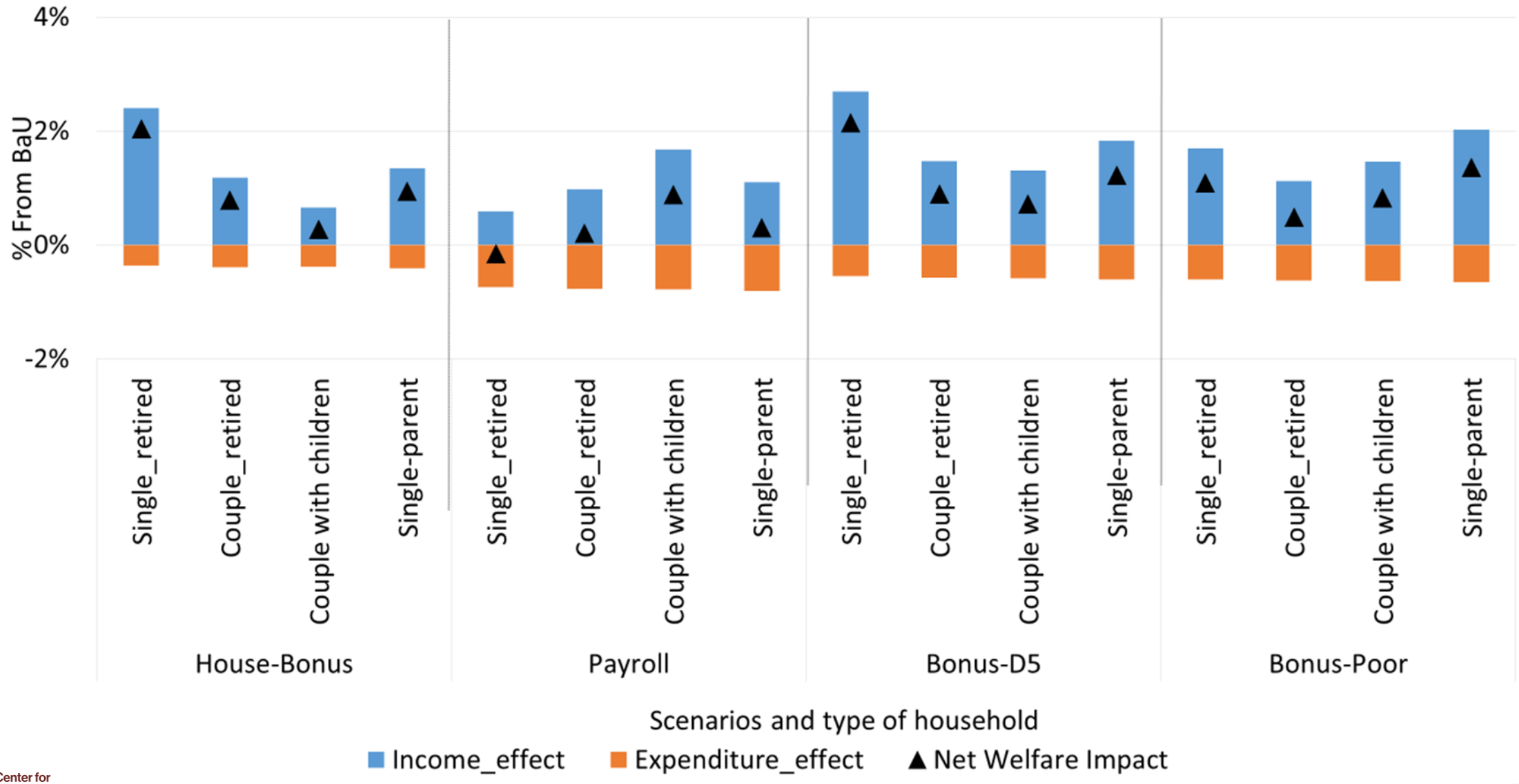
USREP and Micro Household data

- We apply a decomposition algorithm to integrate all ~ 13,000 households from the Consumer Expenditure Survey (CEX) as individual agents into a version of the USREP model
- Integrating economy-wide USREP model and microdata making it possible to capture rich representation of the heterogeneity of households, allowing us to develop deep social analysis, along with inter-sectoral and price-related effects, which are fundamental for analyzing the implications of low carbon pathways.



Social impacts:
Welfare impacts per type of Family



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Full Length Article

US economy-wide decarbonization: Sectoral and distributional impacts☆

Jonathon Becker[a,*], Maxwell Brown[b], Morgan Browning[a], Yongxia Cai[c], Daden Goldfinger[c], James McFarland[a], Sergey Paltsev[d], Shane Weisberg[c], Mei Yuan[d]

[a] Environmental Protection Agency, USA
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[d] Massachusetts Institute of Technology, USA

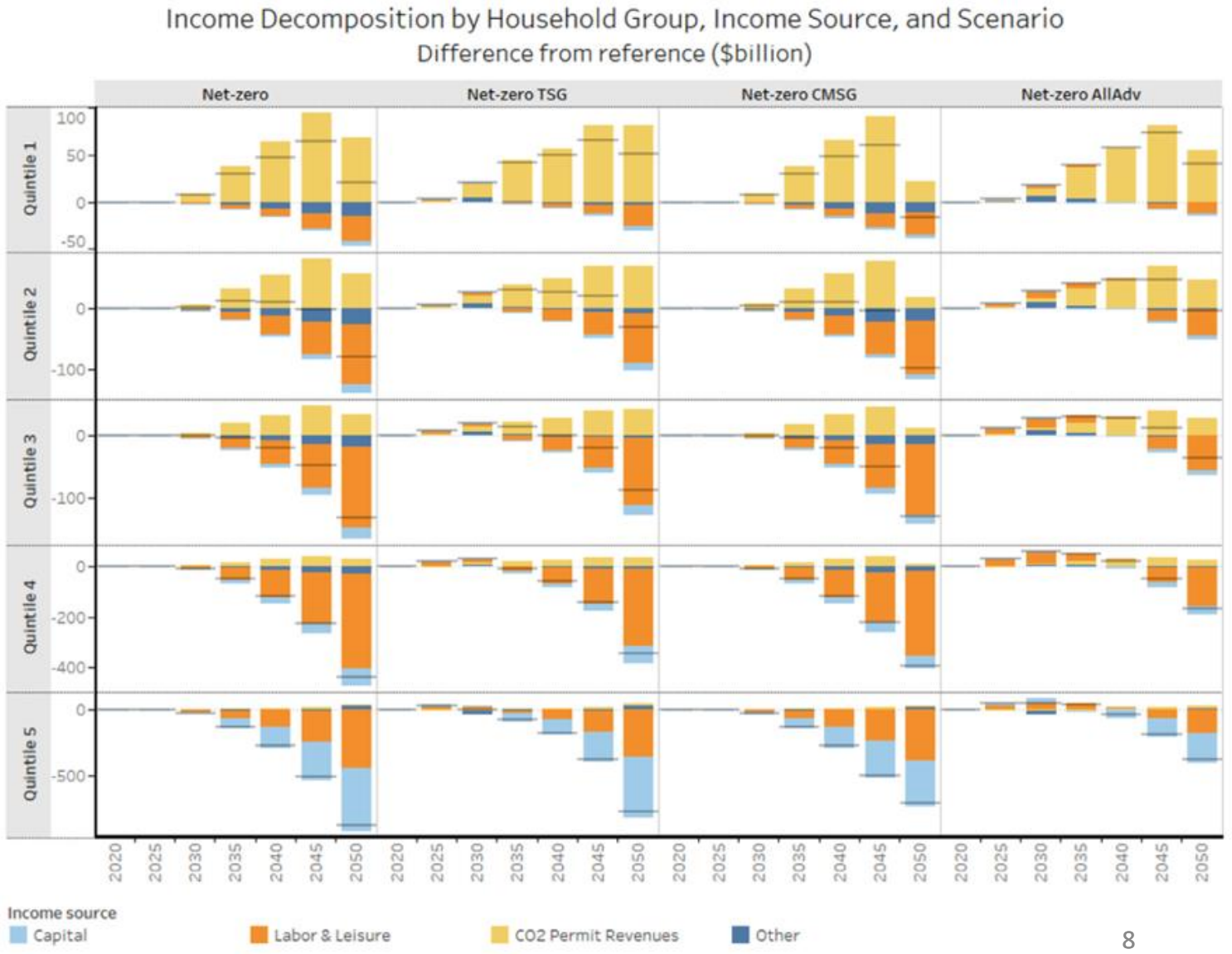
Optimistic technology cost assumptions:
TSG-transport, CMSG-carbon management
AllAdv – all sectors

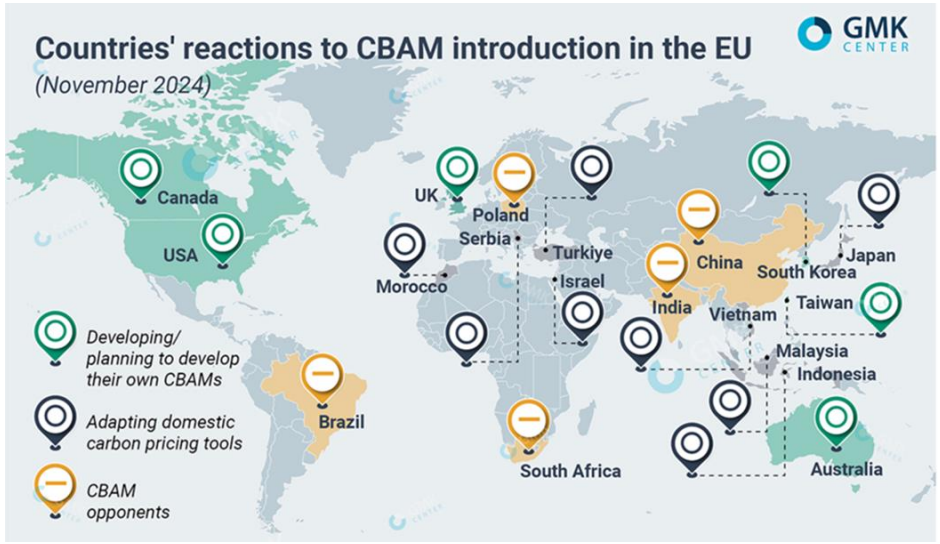
Different Income Groups of the U.S. Population

Lower-income

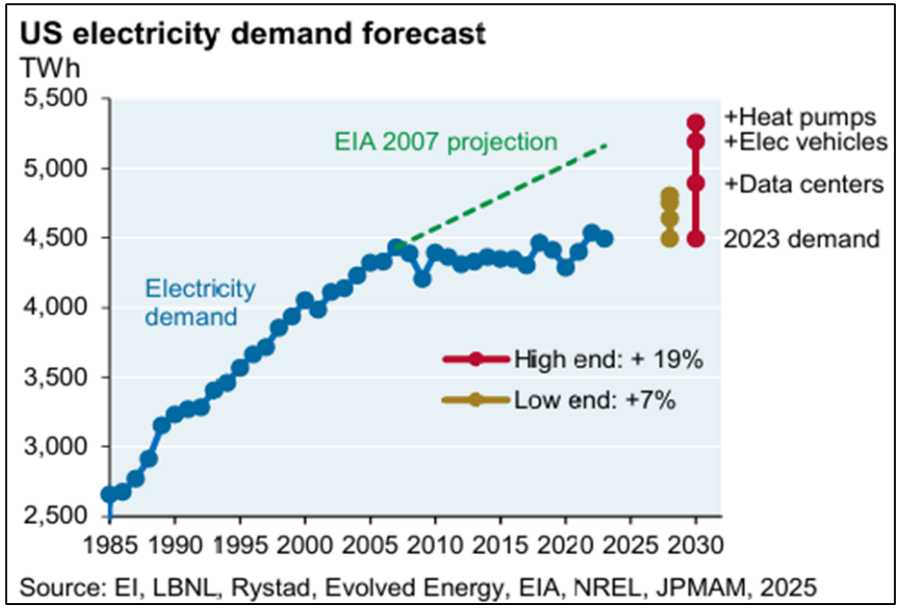
Income gains from CO_2 permit revenue distributed in lump-sum fashion. Income losses from lower economic activities and lower capital earnings.

Higher-income





CARBON CREDITS .com Live Carbon Prices	Last	Change	YTD
COMPLIANCE MARKETS			
European Union	€71.27	-	−5.21%
UK	$45.89	-	+26.14%
Australia (AUD)	$33.10	-	−8.69%
New Zealand (NZD)	$60.05	-	−3.92%
South Korea	$5.92	-	−8.54%
China	¥87.78	-	−9.96%
VOLUNTARY MARKETS			
Aviation Industry Offset	$0.18	-	+38.46%
Nature Based Offset	$0.46	-	−20.69%
Tech Based Offset	$0.35	-	-



https://cs3.mit.edu/publication/118414