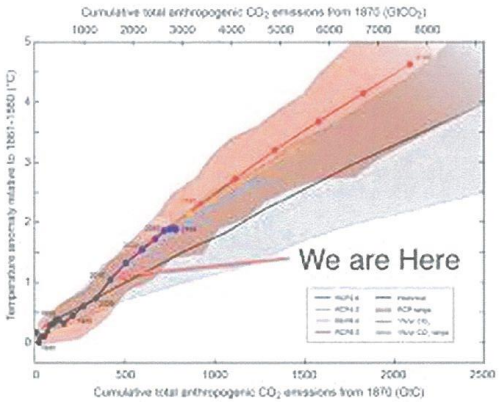
How to set National GHG Emissions Reduction Target After the 2015 Paris Climate Agreement



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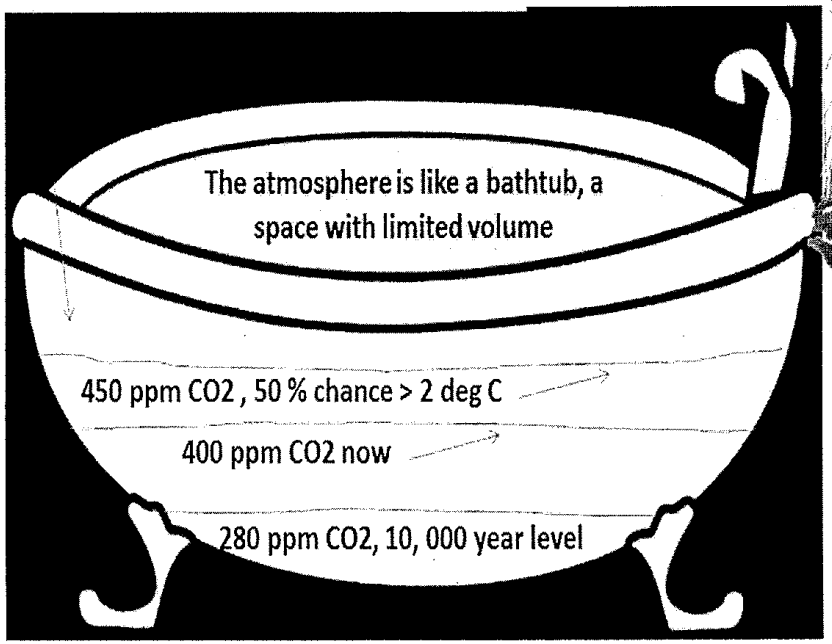
Major Positive Developments in Paris

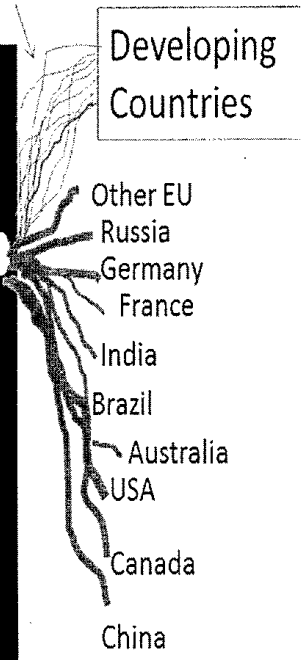
- 186 nations made commitments to reduce ghg emissions, far short of 2° C goal
- Nations agreed to limit the increase in global average temperatures to "well below 2° C" and to "pursue efforts" to limit temperature increase to 1.5 ° C.

- The Paris Agreement, **GHG emissions must be no greater than sinks by the second half of this century**

The Justice Question: What levels of GHGs will be permitted in the bathtub given that the higher the levels--the greater the harms to those countries and millions of poor people that have done little to fill the bathtub and given some levels of warming are an existential threat to millions of poor people around the world.

The Equity Question: Who gets to fill the rest of the atmospheric bathtub given limited remaining space to limit atmospheric GHG concentrations to safe levels, different historical and per capita emissions that have filled the bathtub to current levels, and the needs of poor countries to grow economically.





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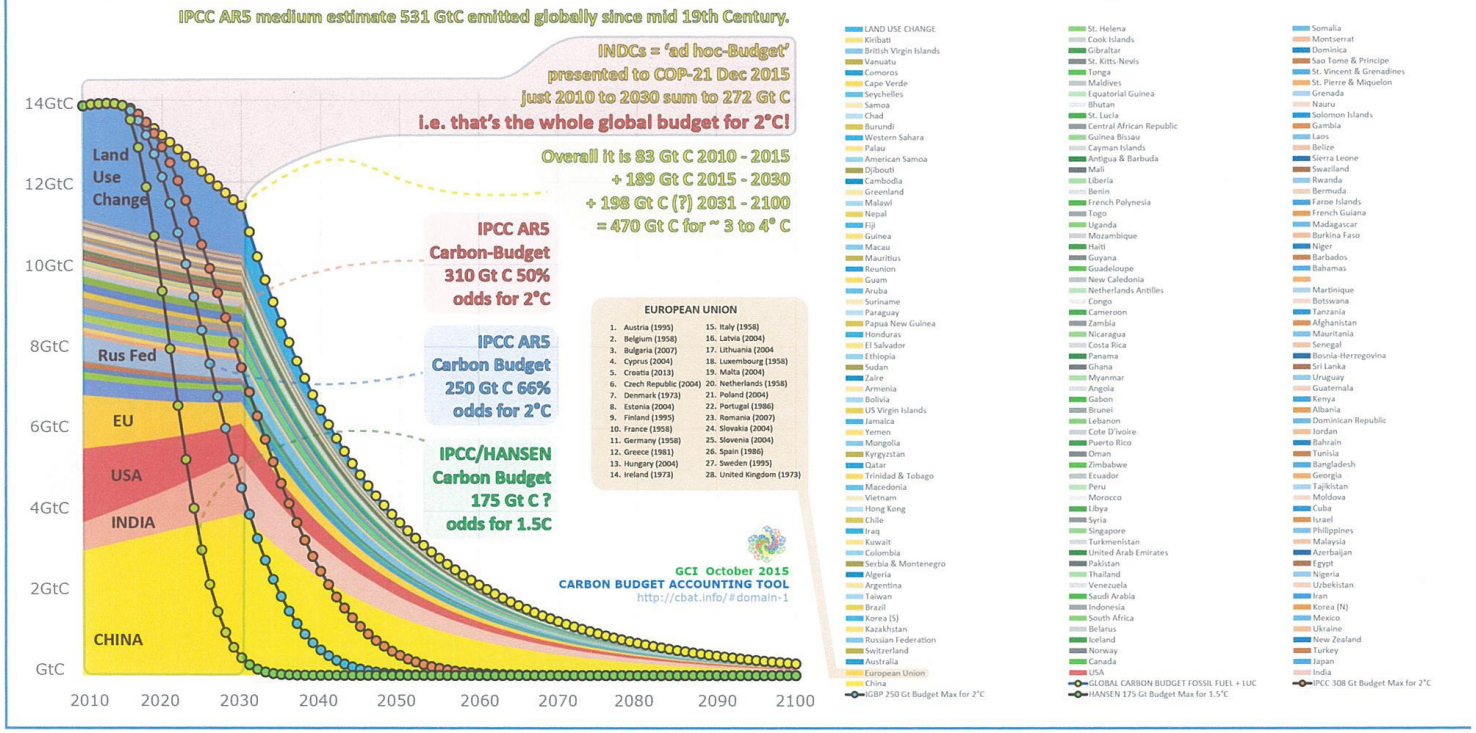
COP-21 International INDCs 20 2030, compared with Global Carbon Budgets for 1.5° & 2.0°C



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Box 2.1: The global carbon dioxide (CO_2) budget, non-CO_2 GHGs and the link to global warming

Limiting warming to any desired level requires a cap on total, cumulative anthropogenic CO_2 emissions. Working Group I of the IPCC (IPCC, 2013) showed that global mean temperature increases are almost directly proportional to cumulative carbon dioxide emissions since the pre-industrial period. This leads to the important conclusion that there is a maximum amount of carbon dioxide emissions, or a CO_2 budget, that can be discharged to the atmosphere over time if society wishes to stay within a 2°C or other global warming limit. The IPCC indicated that to limit warming to below 2°C with a 'likely chance' (that is >66% chance) by the end of the century, about 1 000 $GtCO_2$ of CO_2 emissions remained 'in the budget' from 2011 onward* (IPCC, 2014b; Knutti and Rogelj, 2015). To keep CO_2 emissions within such a budget allowance, annual global CO_2 emissions have to become zero at some point during the 21st century. This is a geophysical requirement that applies regardless of the budget level chosen. For non-CO_2 GHGs with a shorter lifetime in the atmosphere, such as methane, the levels of emissions that are emitted per year are more important than the cumulative amount**. Reducing their annual emissions is also important to limit global mean temperature increase to low levels. Table 2.1 indicates the year of global annual emissions becoming net zero for each of the pathways considered.

* This number is accompanied by an uncertainty range, which depends on the concurrent mitigation of non-CO_2 GHGs.
** This is approximately true, as for non-CO_2 GHGs that stay in the atmosphere for quite a while (for example, N_2O has an atmospheric lifetime of 121 years) there is also a more limited cumulative effect. See, for example, Smith *et al.* (2012).

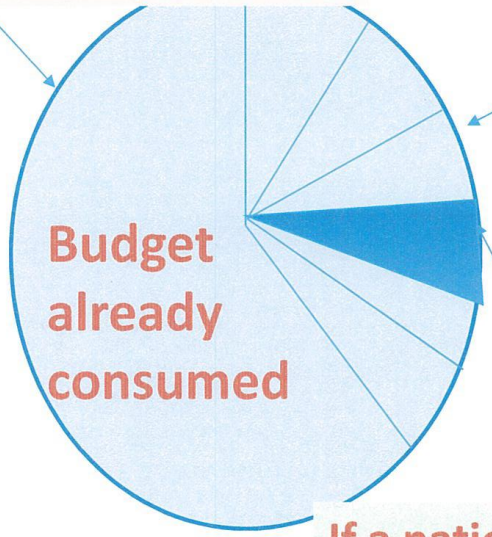
Table 2.1: Overview of pathway characteristics of 1.5°C and 2°C scenarios based on a re-analysis of the IPCC AR5 Scenario Database and a recent study on 1.5°C scenarios[15].
All scenarios have prescribed 2020 emissions consistent with the GHG pledges made by Parties in Cancun in 2010, and hence do not represent least-cost emission levels until then. All available scenarios with limited action until 2020 rely on net negative CO_2 emissions from energy and industry during the 21st century. Most scenarios with such specifications were contributed to the IPCC AR5 Scenario Database by the LIMITS intercomparison project[16]. Note that this table provides data for limiting warming below 1.5°C and 2°C in 2100. Further information is provided in the Tables of Annex A (available online)

Limiting warming in 2100 (allowing for overshoot)					
1.5°C (>50% in 2100)	Pathways limiting warming to below 1.5°C by 2100 with >50% chance. Limited action until 2020 and least-cost mitigation afterwards				
Number of available scenarios: 6; Number of contributing modelling frameworks: 2 Year of global annual emissions becoming net zero† for: Kyoto-GHGs: **(2060-2080)**; total CO_2 (including LULUCF): **(2045-2050)**; CO_2 from energy and industry: **(2045-2055)**					
	Annual emissions of global total greenhouse gases [$GtCO_2e$/yr]				
Year	2020	2025	2030	2050	2100
median*	**56**	**47**	**39**	**8**	**-5**
range and spread**	53(-/-)56	46(-/-)48	37(-/-)40	4(-/-)14	-5(-/-)-3
2°C (>66% in 2100)	Pathways limiting warming to below 2°C by 2100 with >66% chance. Limited action until 2020 and least-cost mitigation afterwards				
Number of available scenarios: 10; Number of contributing modelling frameworks: 4 Year of global annual emissions becoming net zero† for: Kyoto-GHGs: **2085 (2080-2090)**; total CO_2 (including LULUCF): **2070 (2060-2075)**; CO_2 from energy and industry: **2070 (2060-2075)**					
	Annual emissions of global total greenhouse gases [GtCO2e/yr]				
Year	2020	2025	2030	2050	2100
median*	**52**	**48**	**42**	**23**	**-3**
range and spread**	49(49/53)55	44(46/50)53	29(31/44)44	17(18/27)29	-11(-9/-1)0
2°C (50-66% in 2100)	Pathways limiting warming to below 2°C by 2100 with 50-66% chance. Limited action until 2020 and least-cost mitigation afterwards				
Number of available scenarios: 4; Number of contributing modelling frameworks: 2 Year of global annual emissions becoming net zero† for: Kyoto-GHGs: **(2095-2095)**; total CO_2 (including LULUCF): **(2065-2070)**; CO_2 emissions from energy and industry: **(2070-2080)**					
	Annual emissions of global total greenhouse gases [$GtCO_2e$/yr]				
Year	2020	2025	2030	2050	2100
median*	**53**	**50**	**47**	**28**	**-1**
range and spread**	50(-/-)55	49(-/-)51	46(-/-)48	27(-/-)29	-2(-/-)-1

† Rounded to nearest 5 years. Explanation of format: 'median (20th percentile – 80th percentile)' – for example, '2085 (2080-2090)'; no median is provided if fewer than 10 scenarios are available '(minimum–maximum)' – for example, '(2060-2080)'.
* Rounded to the nearest 1 $GtCO_2e$/yr .
** Rounded to the nearest 1 $GtCO_2e$/yr. Explanation of format: 'minimum value (20th percentile/80th percentile) maximum value' – for example, '44(46/50)53'. No percentiles are provided if fewer than 10 scenarios are available – for example, '46(-/-)48'.

15 See Rogelj et al. (2015a)

Total Carbon Budget To LIMIT warming to 2 or 1.5 degrees C measured in gigatons (1 billion tons)



Remaining Carbon Budget

Each National GHG Reduction Target is implicitly a position on the nation's fair share of the remaining carbon budget

If a nation emits more than its fair share of the remaining carbon budget, it will either require other nations to reduce their GHG emissions to levels smaller than their fair share of the remaining budget or guarantee dangerous climate change

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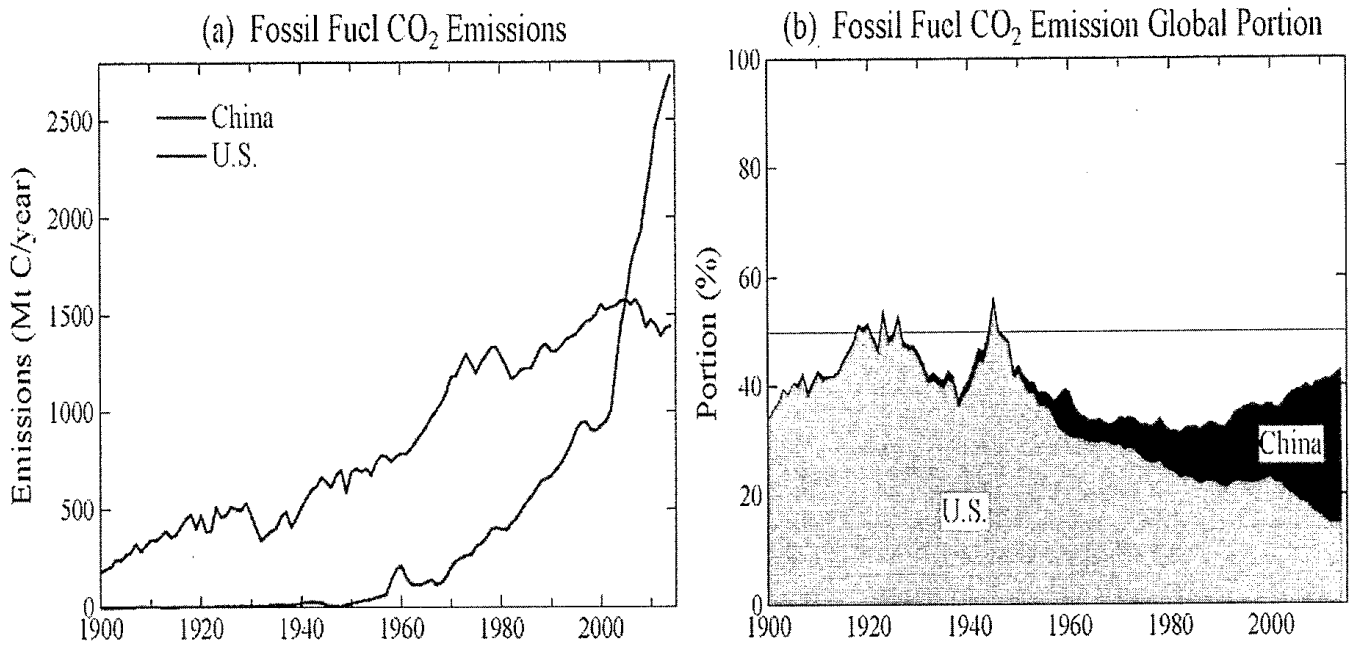
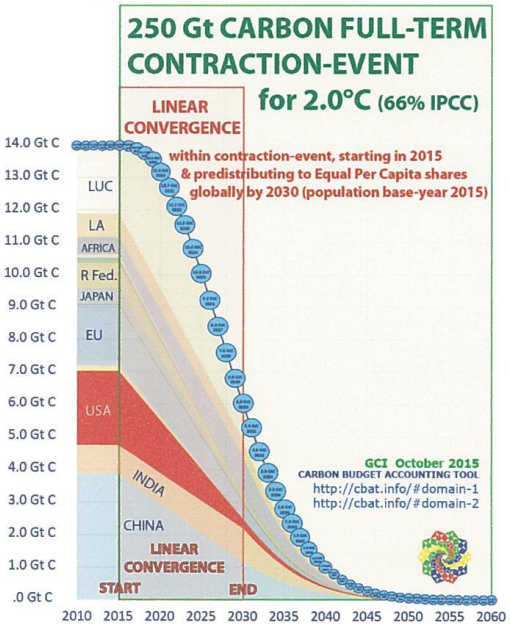
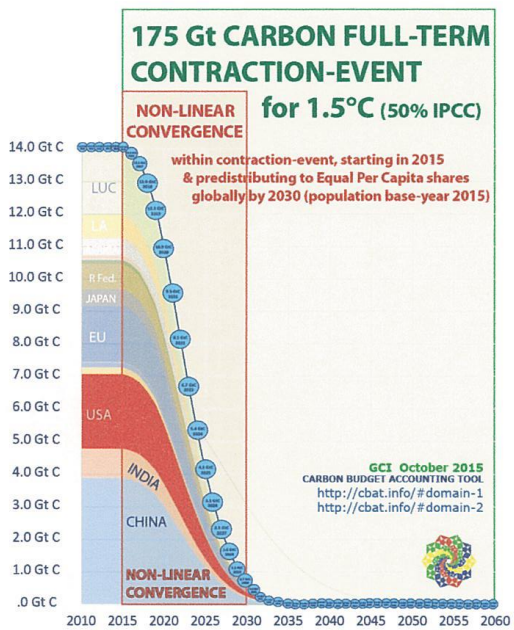
global mean
Africa
S&C Cent.
Middle East
Asia Pacific
rest of Europe & Eurasia
Australia
Canada
U.K.
Germany
Japan
Russia
India
China
U.S.


(a) Fossil Fuel CO_2 Emissions
China
U.S.
Emissions (Mt C/year)
0
500
1000
1500
2000
2500
1900
1920
1940
1960
1980
2000
(b) Fossil Fuel CO_2 Emission Global Portion
Portion (%)
0
20
40
60
80
100
U.S.
China
1900
1920
1940
1960
1980
2000

Emissions Reductions with contraction to equal per capita emissions in 2030



250 GtC Global	
YEAR	US
2010	2.3 Gt C
2011	2.3 Gt C
2012	2.3 Gt C
2013	2.3 Gt C
2014	2.3 Gt C
2015	2.3 Gt C
2016	2.1 Gt C
2017	2.0 Gt C
2018	1.9 Gt C
2019	1.7 Gt C
2020	1.6 Gt C
2021	1.5 Gt C
2022	1.3 Gt C
2023	1.2 Gt C
2024	1.1 Gt C
2025	.9 Gt C
2026	.8 Gt C
2027	.7 Gt C
2028	.5 Gt C
2029	.4 Gt C
2030	.3 Gt C
2031	.2 Gt C
2032	.2 Gt C
2033	.2 Gt C
2034	.1 Gt C
2035	.1 Gt C
2036	.1 Gt C
2037	.1 Gt C
2038	.1 Gt C
2039	.1 Gt C
2040	.0 Gt C
2041	.0 Gt C
2042	.0 Gt C
2043	.0 Gt C
2044	.0 Gt C
2045	.0 Gt C
2046	.0 Gt C
2047	.0 Gt C
2048	.0 Gt C
2049	.0 Gt C
2050	.0 Gt C
2051	.0 Gt C
2052	.0 Gt C
2053	.0 Gt C
2054	.0 Gt C
2055	.0 Gt C
2056	.0 Gt C
2057	.0 Gt C
2058	.0 Gt C
2059	.0 Gt C
2060	.0 Gt C
TOTAL	33.1 Gt C



175 GtC Global	
YEAR	US
2010	2.3 Gt C
2011	2.3 Gt C
2012	2.3 Gt C
2013	2.3 Gt C
2014	2.3 Gt C
2015	2.3 Gt C
2016	2.2 Gt C
2017	2.2 Gt C
2018	2.1 Gt C
2019	2.0 Gt C
2020	1.8 Gt C
2021	1.5 Gt C
2022	1.3 Gt C
2023	1.1 Gt C
2024	.9 Gt C
2025	.7 Gt C
2026	.5 Gt C
2027	.4 Gt C
2028	.3 Gt C
2029	.2 Gt C
2030	.1 Gt C
2031	.1 Gt C
2032	.0 Gt C
2033	.0 Gt C
2034	.0 Gt C
2035	.0 Gt C
2036	.0 Gt C
2037	.0 Gt C
2038	.0 Gt C
2039	.0 Gt C
2040	.0 Gt C
2041	.0 Gt C
2042	.0 Gt C
2043	.0 Gt C
2044	.0 Gt C
2045	.0 Gt C
2046	.0 Gt C
2047	.0 Gt C
2048	.0 Gt C
2049	.0 Gt C
2050	.0 Gt C
2051	.0 Gt C
2052	.0 Gt C
2053	.0 Gt C
2054	.0 Gt C
2055	.0 Gt C
2056	.0 Gt C
2057	.0 Gt C
2058	.0 Gt C
2059	.0 Gt C
2060	.0 Gt C
TOTAL	31.0 Gt C

What Should The US and Pa GHG Emissions ReductionTarget Be?

Carbon Neutral As Soon As Possible But No Later Than 2040.

This is based on converging on equal per capita shares after 2030 and achieving global reductions necessary to limit warming to 1.5 degrees. According to UNEP, the electricity and energy sector for the entire world must be carbon neutral between 2045 and 2050.

What questions should be asked of proponents of continued use of natural gas on the record.

1. How is the United States and Pennsylvania going to assure that carbon emissions are no greater than carbon sinks by no later then 2040 if governments continue to rely on natural gas?
2. Do proponents of natural gas agree that the US and Pennsylvania must as quickly as possible replace fossil fuel with non-fossil fuel to limit warming to non-dangerous levels?
3. Will proponents of continued increase use of natural gas work with the State to replace fossil fuel with non-fossil fuel as quickly as possible?