Institute for Policy Studies

Poor People's Moral Budget: Everybody Has the Right to Live
Appendix: Climate Response

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This section addresses the required public investment to address the following Poor People's Campaign demand, and the resulting social and economic benefits:
We demand 100 percent clean, renewable energy and a public jobs program to transition to a green economy that will put millions of people in sustainable living wage jobs.

We compare the cost of meeting this demand with the benefit of avoided climate change impacts. We have adopted targets based on the Intergovernmental Panel on Climate Change (IPCC), and made assumptions about the scope of the demand and the target date, as follows.

Assumption 1: We have limited the scope of this demand to the electricity sector.
Renewable energy could be used in many sectors, including transportation and primary (non-electric) energy use in industry and in residential and commercial buildings. However, displacing dirty energy in the transportation sector as well as primary dirty energy in buildings entails electrification (replacing internal combustion engine vehicles with electrified public transit and electric vehicles, and replacing natural gas furnaces and water heaters with electric heat pumps). The major shift in *energy sources* to shift the transportation, residential, and commercial sectors to clean energy therefore need to occur in the electricity sector.

Assumption 2: We have expanded the scope of this demand to include energy efficiency.
While the language of the demand talks only about clean, renewable energy, we have for several reasons expanded the demand to include energy efficiency:

- A study of feasible pathways to reduce U.S. greenhouse gas emissions 80% below 1990 levels by 2050[1] (which the study finds to be the reductions the U.S. must make to keep global average temperature increase to within 2 degrees Celsius (2ºC) above pre-industrial levels), finds that overall energy use in the U.S. must decrease between 18 and 22% below 2014 levels by 2050. The recent IPCC report shows that a 2ºC target is insufficient and we should set a 1.5ºC target instead. [2] *Clearly, we need even more ambitious energy efficiency targets.*
- Combining renewables expansion with energy efficiency makes the transition more cost effective. A 2018 study found the average cost per unit for electric energy efficiency investments to be $25/MWh.[3] This is lower than costs per unit of power generation (including capital and operating cost) from newly installed generating capacity of the three cheapest ways to generate electricity: $41.60/MWh for geothermal energy, $48/MWh for wind energy, and $49/MWh for natural gas power plants. [4] The cost per unit for geothermal and wind energy are reduced to reflect tax credits that these sources are eligible for, since the tax credits effectively reduce the price per unit generated.[5]
- Energy efficiency can be thought of as an energy source (since it displaces other sources of energy), and is treated as one in some states through Energy Efficiency Resource Standards (EERS).[6]

Numerical Target

The IPCC has determined that meeting a 1.5ºC temperature increase threshold requires reduction of emissions from human activities to 45% below 2010 levels by 2030, and zero emissions by 2050. [7] However, in terms of public investment, a 30+ year window is hard to plan for. Most Federal budget plans, for instance, cover a 10-year window.[8] We have therefore made the choice of determining the public cost of a pathway to get emissions from the U.S. electricity sector to 45% below 2010 levels by 2030, which is *consistent with* a pathway to get to zero emissions by 2050, and meets the intermediate goal identified by the IPCC.

To stay on this pathway would obviously require further public investment after the 10-year window, to get to 100% renewables (and zero emissions) from the electricity sector by 2050. However, there are good reasons to be optimistic that meeting the intermediate target of 45% emissions reduction by 2030 would facilitate meeting the final target of 100% renewables (and zero emissions) by 2050.

Renewables have essentially achieved cost parity with fossil fuels, with facility lifetime cost of geothermal energy ($44.60/MWh) being cheaper than natural gas ($49/MWh) even without a tax credit, and wind and solar energy within striking distance ($59.10/MWh and $63.20/MWh, respectively).[9] Further R&D in renewable energy is only going to drive the costs of renewables down further.

The main technical obstacles to wider penetration of renewables are the intermittency of solar and wind energy, and the high cost of energy storage. However, costs of energy storage are projected to decrease rapidly. The costs of lithium-ion batteries, a particularly promising form of energy storage, decreased 60% for electric grid applications in Germany between the fourth quarter of 2014 and the second quarter of 2017, and are expected to decrease between 54% and 61% through 2030.[10]

State Renewable Portfolio Standards (RPS) are another factor that will likely drive growth in renewables beyond 2030. Renewable Portfolio Standards (RPS) are binding requirements set by states for electric utilities to provide a growing share of electricity from renewable sources on a specified timeline. Currently, 29 states, the District of Columbia, and Puerto Rico have RPS requirements.[11] Two states, California[12] and Hawai'i,[13] have an RPS of 100% by 2045, and the District of Columbia has a target of 100% by 2032,[14] exceeding the goal of 100% by 2050 implied by the IPCC. Three other states, Vermont (75% by 2032), New Jersey, and New York (both 50% by 2030) exceed the intermediate goal of 45% by 2030.[15]

RPS policies have historically been the single largest driver of growth in renewable energy capacity, accounting for more than half of renewables capacity additions between 2000 and 2016.[16] We can therefore expect continued renewables capacity growth to meet existing RPS goals.

Finally, as the costs of renewables and energy storage fall, and as the share of renewables in the grid and the installed energy storage capacity rise, there will be a "tipping point" where renewable energy growth will accelerate. A consulting firm has forecast that such a tipping point could come in 2035 with worldwide penetration of renewable energy of only 20%, and could come sooner with more ambitious policies in place.[17] If a tipping point could come at a 20% penetration, it could certainly come at a 45% penetration, especially with supportive policies and robust public investment (as we are calling for) in place. This makes us even more confident that a pathway to get to 45% renewables by 2030 could lead to 100% renewables by 2050.

Cost Estimate

According to a 2014 report, an annual average of $50 billion in gross public investment in clean energy and energy efficiency (not accounting for public savings in health care from pollution reduction and other areas), supplemented with $150 billion in private investment for an annual total of $200 billion, will reduce U.S. emissions of carbon dioxide to 3,051 million metric tons by 2030.[18] This represents a 46.5%

reduction from 2010 emissions of 5,701 metric tons[19], clearly meeting the IPCC requirement of at least a 45% reduction.

The two broad areas of investment that the report covers are: [20]

- Energy efficiency investments in buildings, transportation, and industry.
- Investments in renewable energy generation infrastructure.

The four classes of policy interventions considered are:[21]

- Market-shaping rules (such as Renewable Portfolio Standards and vehicle fuel efficiency standards), which require private investment for compliance but do not entail public spending.
- Direct public spending (for example, capital expenditures in energy efficiency projects for public buildings, and R&D expenditures for advanced renewable energy technologies).
- Tax credits to incentivize private investment in renewables and energy efficiency.
- Transitional support for fossil fuel-dependent communities and workers.

We have identified $50 billion annually as the scale of public investment required.

Offsetting Economic Benefits

Investment in a pathway to 100% clean energy will lead to economic benefits for society as a whole, and resulting benefits to public finances. These include reduction in deaths, illnesses, and injuries attributable to extreme heat, wildfires, violent storms, etc.; reduction in associated health care costs, disaster relief spending, and days of work lost; reduction in infrastructure damage from sea level rise, wildfires, and storms; reduction in agricultural losses from droughts, etc.

However, separating out the impact of a clean energy transition in the U.S. alone on reducing these losses is not possible because of the global nature of climate change causation (meaning, even if the U.S. cuts its emissions, it could still suffer some or all of these losses if other high-emitting countries continue on their current emissions trajectory). Also, the interventions in this demand address emissions from the electric power generation and building energy use sectors, but not from other sectors of the U.S. economy such as transportation and agriculture.

To address these uncertainties, we make the following two assumptions:

- ***Emissions reduction policies and investment in other sectors also occur in a manner and on a scale consistent with the 1.5ºC goal***. This may be a "tall order." However, in a political environment in which this demand is met, we can assume that similar demands around, say, transportation are also met.
- ***Other countries also take climate action at a scale and speed consistent with the 1.5ºC goal.*** This is also a "tall order." However, while very few countries have truly ambitious policies to address climate change, the U.S. is a "global outlier" today in terms of how bad its climate and energy policies are. Climate Action Tracker, a global research consortium, tracks countries' pledged greenhouse gas reductions in the Paris Climate Accord process.[22] According to their ratings, the U.S. is one of only four countries with a pledge that is "critically insufficient,"[23] which means that the pledged greenhouse gas reductions are "not at all consistent with holding warming to below 2 degrees Celsius, let alone with the Paris Agreement's stronger 1.5 degrees Celsius limit."[24] Global average temperature increase would be 4 degrees Celsius if all countries' pledges were in the same range as the U.S. If we win demands such as this in the U.S., there is no reason to believe that other countries with high emission levels won't implement at least similar if not more ambitious policies.

Given these assumptions, we can assign the ***full economic benefit*** of keeping global average temperature increase to within 1.5ºC to the success of this demand (in conjunction with equally ambitious greenhouse gas reductions in other sectors of the U.S. economy, and in other countries).

A 2017 study estimates the impact of temperature increase on the U.S economy in terms of share of GDP lost, and finds that the likely range of losses varies with the level of global average temperature increase as shown in Table 1 below.[25]

Table 1. Estimated Ranges of Aggregate Annual Nationwide Economic Losses for U.S. as Share of GDP for Different Warming Scenarios.[26]
(Economic Losses Reported as % of GDP per Year)

Temperature Increase (ºC)	Low-End Estimate of Economic Loss	High-End Estimate of Economic Loss
1.5ºC	+0.1%	-1.7%
4ºC	-1.5%	-5.6%
8ºC	-6.4%	-15.7%

To underscore the potential damage from doing nothing, ***economic losses could rise to as much as 15.7% of GDP per year*** if the planet warms by 8ºC. With reference to the current U.S. GDP of $20.87trillion,[27] it is equivalent to wiping out $3.3 trillion from the U.S. economy.

Our most conservative estimate of savings from meeting this demand based on the numbers presented in Table 1, using the low end of economic damage from any given temperature increase scenario, and assuming a worst-case temperature increase of 4ºC (as against a catastrophic 8ºC), is ***1.6% of GDP***. (This is the difference between a +0.1% gain at 1.5 ºC warming and a -1.5% loss at 4ºC warming.) Based on current GDP of $20.87 trillion,[28] this represents an annual economic loss of about ***$334 billion***.

Therefore, the net benefit of a $200 billion per year investment in renewable energy (based on all of our qualifying assumptions) is about $134 billion.

Other benefits of investment in a clean energy transition are attributable to the net increase in jobs because of the investment. A $200 billion per year investment in a clean energy transition will create 4.2 million overall jobs, and 2.7 million net jobs (accounting for an expected decrease of 1.5 million fossil fuel-related jobs.)[29] Net job creation on this scale will benefit the economy overall, lead to increased tax revenues for governments, and reduce required safety net expenditures.

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[1] Deep Decarbonization Pathways Project (DDPP), "Pathways to Deep Decarbonization in the United States," U.S. 2050 Vol. 1, Technical Report, November 2015, available at: http://deepdecarbonization.org/wp-content/uploads/2015/11/US_Deep_Decarbonization_Technical_Report.pdf

[2] Intergovernmental Panel on Climate Change (IPCC), "Global Warming of 1.5ºC: Summary for Policymakers," October 2018, available at: http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

[3] Hoffman, Ian , Charles A. Goldman, Sean Murphy, Natalie Mims, Greg Leventis and Lisa Schwartz, "The Cost of Saving Electricity Through Energy Efficiency Programs Funded by Utility Customers: 2009–2015," Lawrence Berkeley National Laboratory Electricity Markets and Policy Group, June 2018, available at: http://eta-publications.lbl.gov/sites/default/files/cose_executive_summary_20180619.pdf

[4] U.S. Energy Information Administration (EIA), "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2018," March 2018, Table 1b, p. 6, available at: https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf
[5] Ibid., box on p. 2.
[6] American Council for an Energy Efficient Economy (ACEEE), Energy Efficiency Resource Standard (EERS), available at: https://aceee.org/topics/energy-efficiency-resource-standard-eers
[7] Intergovernmental Panel on Climate Change (IPCC), "Global Warming of 1.5ºC: Summary for Policymakers," October 2018, available at: http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf. Carbon dioxide is only one of several greenhouse gases, and the IPCC has identified pathways to reduce emissions of other greenhouse gases as well.
[8] See, for example, Congressional Budget Office (CBO), "CBO's Cost Estimates Explained," September 2018, available at: https://www.cbo.gov/system/files?file=2018-09/54437-CBO-CostEstimates-Explained.pdf
[9] U.S. Energy Information Administration (EIA), "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2018," March 2018, Table 1b, p. 6, available at: https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf
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[11] National Council of State Legislatures (NCSL), STATE RENEWABLE PORTFOLIO STANDARDS AND GOALS, updated 7/20/2018, available at: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.
[12] California Senate Bill No. 100, Renewables Portfolio Standard Program, Approved by Governor September 10, 2018. Filed with Secretary of State September 10, 2018, available at: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100
[13] National Council of State Legislatures (NCSL), STATE RENEWABLE PORTFOLIO STANDARDS AND GOALS, updated 7/20/2018, available at: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.
[14] "Mayor Bowser Signs Historic Clean Energy Bill, Calling for 100% Renewable Electricity by 2032," District Department of Energy and Environment press release, 1/18/2019, available at: https://doee.dc.gov/release/mayor-bowser-signs-historic-clean-energy-bill-calling-100-renewable-electricity-2032
[15] National Council of State Legislatures (NCSL), STATE RENEWABLE PORTFOLIO STANDARDS AND GOALS, updated 7/20/2018, available at: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.
[16] Barbose, Galen, "U.S. Renewables Portfolio Standards: 2017 Annual Status Report," Lawrence Berkeley National Laboratory Report LBNL-2001031, July 2017, available at: http://eta-publications.lbl.gov/sites/default/files/2017-annual-rps-summary-report.pdf. Note that this is not a strict attribution, and some of the capacity growth attributed to RPS may have occurred regardless. This is, however, the amount of capacity growth that was required to meet RPS mandates.
[17] Wood Mackenzie, "Thinking global energy transitions: the what, if, how and when," June2018, available (with free registration) at: https://www.woodmac.com/news/feature/global-energy-transition/
[18] Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Bracken Hendricks, "Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities," Political Economy Research Institute (PERI), University of Massachusetts Amherst, and Center for American Progress, September 2014, available at: https://www.americanprogress.org/issues/green/reports/2014/09/18/96404/green-growth/
[19] U.S. Environmental Protection Agency (EPA), Greenhouse Gas Inventory Data Explorer, https://www3.epa.gov/climatechange/ghgemissions/inventoryexplorer/#allsectors/allgas/gas/all
[20] Pollin, Robert, Heidi Garrett-Peltier, James Heintz, and Bracken Hendricks, "Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities," Political Economy Research Institute (PERI), University of Massachusetts Amherst, and Center for American Progress, September 2014, available at: https://www.americanprogress.org/issues/green/reports/2014/09/18/96404/green-growth/
[21] Ibid.
[22] Climate Action Tracker, https://climateactiontracker.org/about/

[23] Ibid., country ratings, https://climateactiontracker.org/countries/
[24] Ibid., explanation of ratings system, https://climateactiontracker.org/countries/rating-system/
[25] Hsiang, Solomon, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D. J. Rasmussen, Robert Muir-Wood, Paul Wilson, Michael Oppenheimer, Kate Larsen, and Trevor House, "Estimating economic damage from climate change in the United States," Science, Vol. 356, Issue 6345, pp. 1362-1369, 6/30/2017, available at: http://science.sciencemag.org/content/356/6345/1362
[26] Ibid.
[27] U.S. Bureau of Economic Analysis, "Gross Domestic Product, Fourth Quarter and Annual 2018 (Third Estimate); Corporate Profits, Fourth Quarter and Annual 2018," 3/28/2019, available at: https://www.bea.gov/news/2019/gross-domestic-product-4th-quarter-and-annual-2018-third-estimate-corporate-profits-4th
[28] Ibid.
[29] Pollin et. al., 2014.