

A Strong Rebuttal to an Op-Ed by Senator Rand Paul  
(Fox News Opinion, May 22, 2017)

<http://climatefeedback.org/rand-paul-argument-withdrawing-paris-climate-agreement-based-flawed-information-prof-gary-yohe-explains/>

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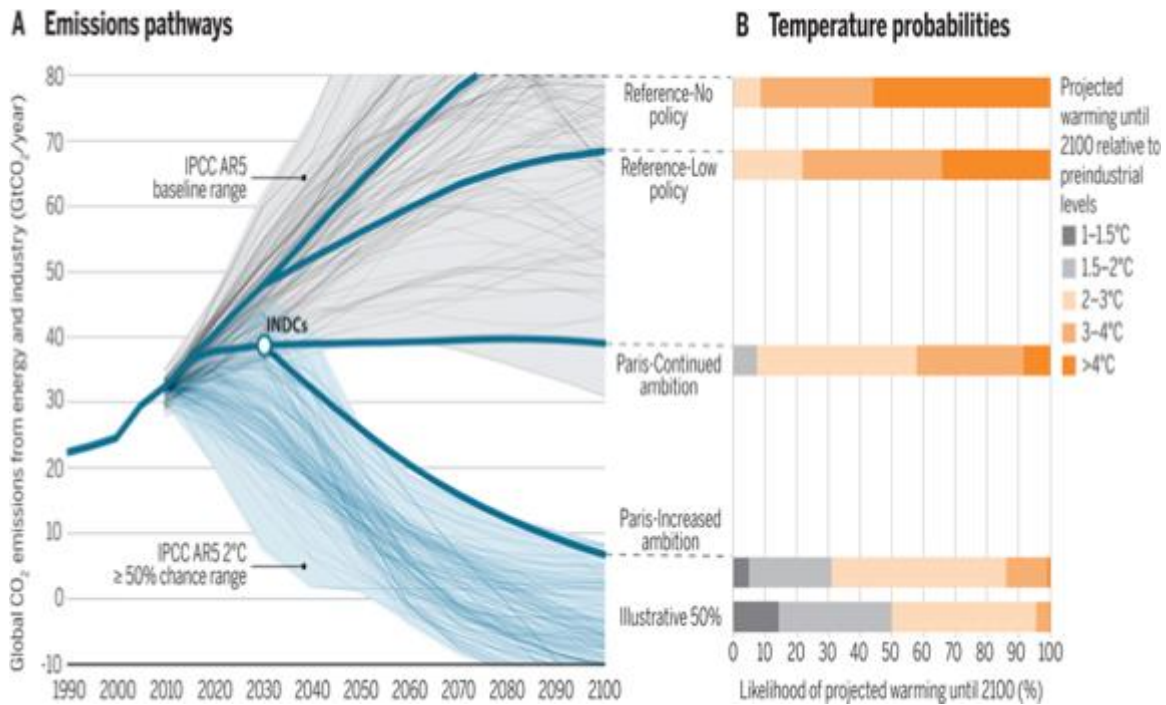
Senator Paul's opinion piece includes several sentences to which I take strong exception. The first four appear together in his third paragraph:

*"So what did Obama sign us up for in exchange for maybe reducing global temperature by 0.2°C by 2100? Experts predict that by 2040, the agreement could cost us 6.5 million lost jobs—a number significantly larger than the entire population of Kentucky. It will cost us \$3 trillion in lost GDP. For each household, the average annual lost income could be as high as \$4,900."*

Let us take the first sentence by itself; it reads:

*"So what did Obama sign us up for in exchange for maybe reducing global temperature by 0.2°C by 2100?"*

This statement is completely **INCORRECT**. Figure 1 appropriated from Fawcett, et al. (*Science*, November 26, 2015) displays the nuances of correctly projecting the impact of the Paris Accord through 2100. Business as usual creates an emission trajectory that rapidly passes by 80 gigatons of CO<sub>2</sub> per year by 2070; the likelihood of seeing warming less than 3 degrees C through 2100 along this path is 10% with a median of more than 4 degrees C. Abiding by the Paris Accord through 2030 and continuing its momentum through 2100 would increase that likelihood to nearly 60% with a median somewhere around 2.5 degrees C – a reduction of approximately 1.5 degrees C and not 0.2 degrees C.



**Figure 1** (replicated from the Fawcett (2015): Ranges of emissions scenarios with and without the Paris Accord through 2030 and beyond. The bars on the left indicate distributions of warming through 2100, and the trajectories show a no policy case as well as a modest policy, the Paris Accord extended, and an accelerated policy case.

A convenient truth, that increases in global mean temperature are driven by cumulative greenhouse gas emissions over very long periods of time, should also be noted here. This simple, and well-established truth means that near-term reductions in emissions (like those indicated in the Paris Accord) actually remove the most damaging molecules of heat-trapping gases from any long-term trajectory of emissions. As a result, they are first in line to reduce the likelihoods of the extreme and potentially catastrophic consequences of increases in global mean temperature that could, if we do nothing, reach 3 degrees C by mid-century and more than 4 degrees C by the turn of the century unless we take action, now.

The next three sentences read:

*"Experts predict that by 2040, the agreement could cost us 6.5 million lost jobs—a number significantly larger than the entire population of Kentucky. It will cost us \$3 trillion in lost GDP. For each household, the average annual lost income could be as high as \$4,900."*

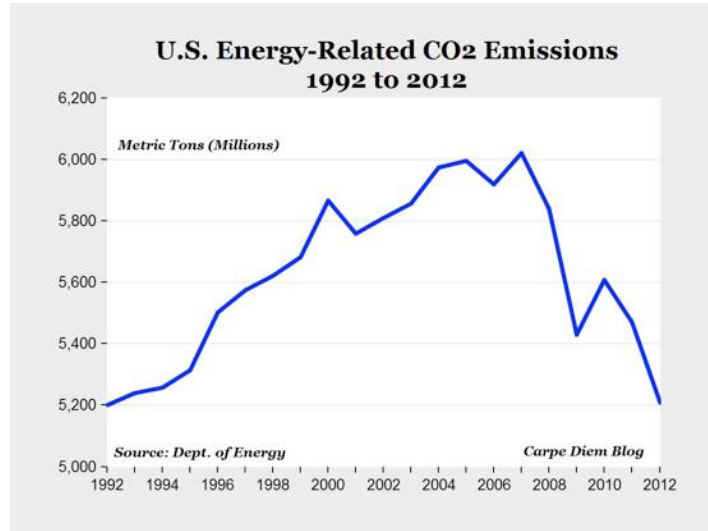
This statement refers to experts who recently produced a report that was commissioned by the American Council for Capital Formation from NERA Economic Consulting. In doing so, Senator Paul is guilty having his mind made up (see the

resolutions that he has submitted to the United States Senate) and finding a group of economists who will produce number that support his view. The numbers he quotes are from an analysis that adds new meaning to the term “business as usual”. They look to frame their vision of the future on the basis of static behavior across major sectors of the economy; i.e., they do not allow their sectors to adapt their business operations in response to changes in their economic environment. This allows the analysis to report prices for carbon that vary by orders of magnitude across 4 major sectors and leads them to expecting investment to fall by nearly 20% at a time where increasing investment in alternative energy and new production technologies would allow them to grow their profits and support more jobs. The reported losses in jobs, GDP and personal income are the result of these rigid assumptions and not their similarly rigid depictions of how the US would implement its plan to meet its Paris Accord target.

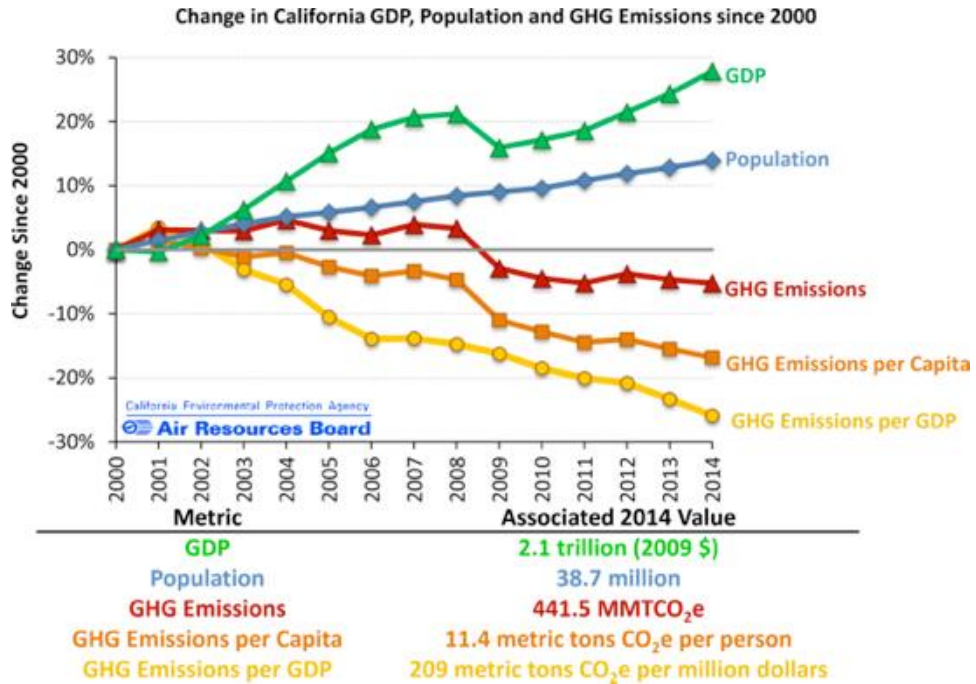
Rather than quote a different report from a different set of experts that show economic growth in both GDP and employment (though they exist, doing so would fall into the same ordering trap as the Senator), let’s look at the recent experience in the United State. Figure 2 shows that US carbon emissions have fallen by 14% since 2006, a period of time during which the unemployment rate also fell from nearly 9% to around 4.4% and annual rate of GDP growth climbed to the historically normal range of 1.5% to 2%. These are rates that the President has claimed as evidence that his approach to the economy is working; indeed, he uses them to suggest that we can achieve 3% growth in before the next election to support his proposed tax cuts. Figure 3 shows emissions falling in California by nearly 8% since 2008 partly in response to a cap and trade program that has generated \$4billion in revenue – revenue that has been used to support investment in adaptation and simultaneous expansion of the employment of less carbon intensive and/or carbon free sources of energy at scale. Over the same period, California GDP has climbed by nearly 10%. These simple economic observations contradict the Senator’s claims.

Is energy transformation on the scale envisioned by those who support the Paris Accord economically feasible? “Yes”, is the simple answer. To see why, look at the current energy mix displayed in Figure 4. It is the end point of the more aggregate time trajectories depicted in Figure 5. Figure 6 depicts projected mixes for 2050 after aggressive emissions reductions across the United States that are consistent, through 2030, with our Paris Accord target and indicates the feasibility of maintaining momentum along the lines displayed by Fawcett, et al. through 2050. Every technology needed to support the Figure 6 portraits across 5 different economic models is currently available at low cost when adopted in due course in a world where carbon is growing predictably more scarce; and taken together, they show that the rigidity of the results quoted by Senator Paul are mere hyperbole.

**Figure 2:** Energy related carbon emissions for the United States (1992-2012)



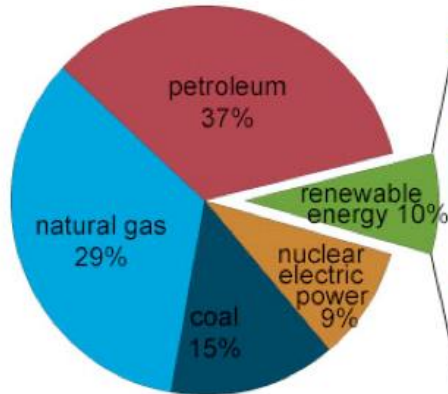
**Figure 3:** Change in California GDP, population, and GHG emissions since 2000.  
Source: California Air Resources Board, 2015



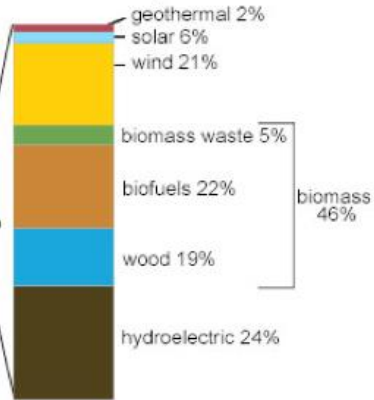
**Figure 4:** Energy mix history of the United States. Source: US EIA Energy Review Monthly, April 2016.

### U.S. energy consumption by energy source, 2016

Total = 97.4 quadrillion  
British thermal units (Btu)



Total = 10.2 quadrillion Btu



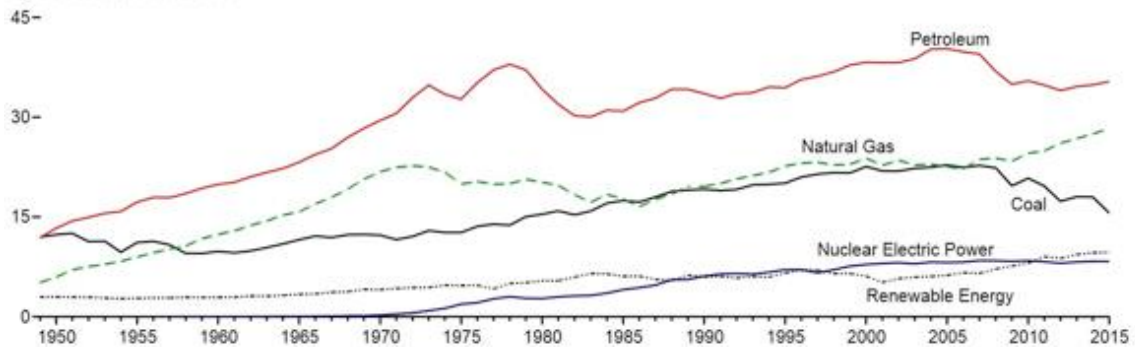
Note: Sum of components may not equal 100% because of independent rounding.

Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2017, preliminary data

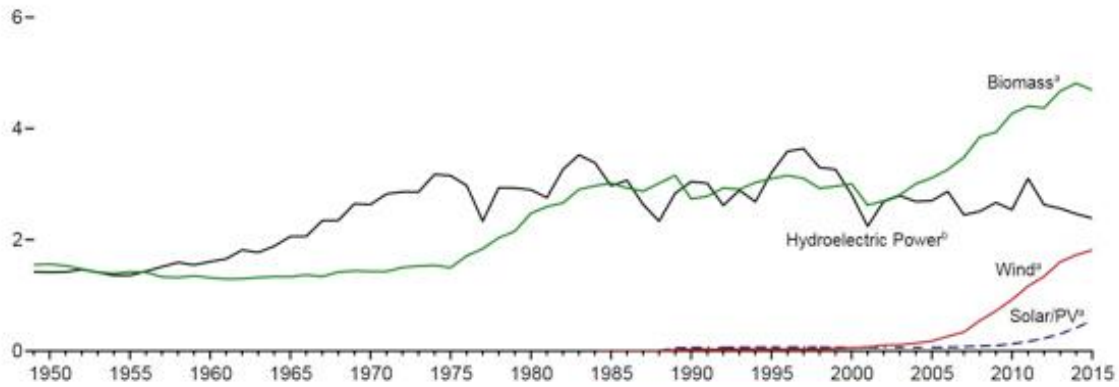


**Figure 5:** History and a projection of the United States energy mix. Source: US EIA Energy Review Monthly, June 2016.

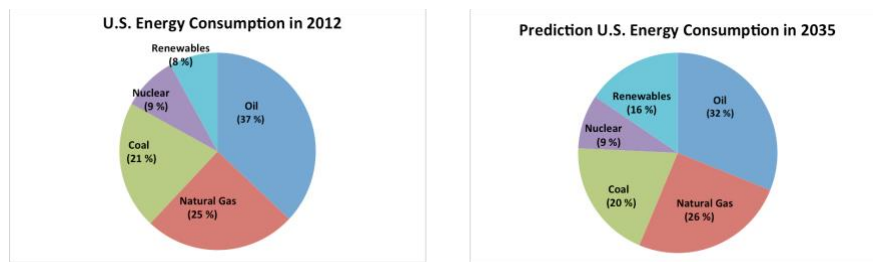
By Source,<sup>a</sup> 1949–2015



Panel A



Panel B



Panel C

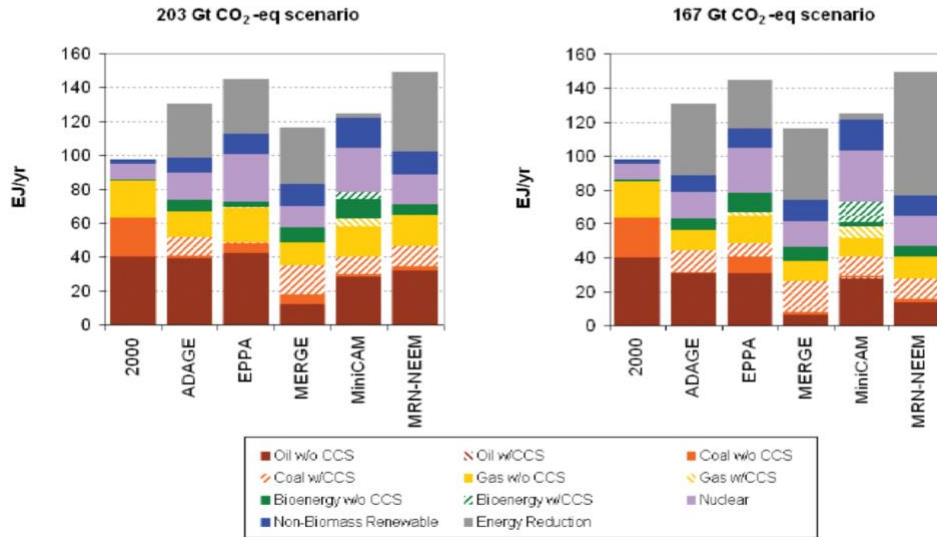
**Caption for Figure 5:** US Energy Consumption History. Source: US EIA Energy Review Monthly, June 2016.

The three major fossil fuels—petroleum, natural gas, and coal—have dominated the U.S. energy mix for more than 100 years. Several recent changes in U.S. energy production have occurred:

- Coal production peaked in 2008 and trended down through 2016. Coal production in 2016 was about the same as production was in 1977. The primary reason for the general decline in coal production in recent years is the decrease in coal consumption for electricity generation.
- Natural gas production in 2016 was the second largest amount after the record high production in 2015. More efficient and cost-effective drilling and production techniques have resulted in increased production of natural gas from shale formations.
- Crude oil production generally decreased each year between 1970 and 2008. In 2009, the trend reversed and production began to rise. More cost-effective drilling and production technologies helped to boost production, especially in Texas and North Dakota. In 2016, crude oil production was lower than production in 2015, mainly because of lower global crude oil prices.
- Natural gas plant liquids (NGPL) are hydrocarbon gas liquids that are extracted from natural gas before the natural gas is put into pipelines for transmission to consumers. NGPL production has increased alongside increases in natural gas production. In 2016, NGPL production reached a record high.
- Total renewable energy production and consumption both reached record highs of about 10 quadrillion Btu in 2016. Hydroelectric power production in 2016 was about 12% below the 50-year average, but increases in energy production from wind and solar helped to increase the overall energy production from renewable sources. Energy production from wind and solar were at record highs in 2016

**Figure 6:** Projected energy mixes for the United States in 2050 with two aggressive emissions targets. Source: Limiting the Magnitude of Future Climate Change, America's Climate Choices, National Research Council, 2010.

Model projections (from e EMF22 study) of the mix of energy technologies that may be used in 2050, under scenarios with emission budgets of 203 and 167 Gt of CO<sub>2</sub> equivalents from five different models using technology available today. Adapted from Fawcett et al. (2009); see also <http://emf.stanford.edu> for further details. Source: America's Climate Choices, National Research Council, 2010.



Finally, the table below reports renewable energy employment numbers for 2016. There are currently more than 416,000 people employed in this growing sector across the United States (see Figure 5), but we nonetheless rank third in the world behind China and Brazil and barely ahead of India. Renewables will be the growth sector of the first half of this century, and pulling out of the Paris Accord would reduce investment incentives in the United States. Leaving the Accord would thereby limit employment growth opportunities at a time where the mantra across the federal government is “Jobs, jobs, jobs”. It is here that the future employment of those displaced by the contraction of, for example, the coal industry, would otherwise be found.

**ESTIMATED DIRECT AND INDIRECT JOBS IN RENEWABLE ENERGY  
WORLDWIDE BY INDUSTRY** (thousands of jobs)

Source: International Renewable Energy Agency, *Annual Review*, 2016

	World	China	Brazil	US	India	Japan	Germany	France	Rest of EU
<b>Solar Photovoltaic</b>	2,772	1,652	4	194	103	377	38	21	84
<b>Liquid Biofuels</b>	1,678	71	821	277 <sub>f</sub>	35	3	23	35	47
<b>Wind Power</b>	1,081	507	41	88	48	5	149	20	162
<b>Solar Heating/Cooling</b>	939	743	41	10	75	0.7	10	6	19
<b>Solid Biomass</b>	822	241		152	58		49	48	214
<b>Biogas</b>	382	209			85		48	4	14
<b>Hydropower (Small)</b>	204	100	12	8	12	5	12	4	31
<b>Geothermal Energy</b>	160			35		2	17	31	55
<b>Total</b>	<b>3,523</b>	<b>918</b>	<b>769</b>	<b>416</b>	<b>388</b>	<b>141</b>	<b>355</b>	<b>170</b>	<b>644</b>

Finally, perhaps the best evidence that Senator Paul is **INCORRECT** here can be found in the opinions of major business leaders from across the nation. The Chief Executive Officers of Apple, BHP Billiron, BP, DuPont, General Mills, Google, Intel, Microsoft, National Grid, Novartis Corporation, Rio Tinto, Schneider Electric, Shell, Unilever, and Walmart have called on the President to stay the course with respect



to United States participation in the Paris Accord. They have done so because they see potential advantages to their bottom lines by acting to reduce material risks that will increasingly be driven by accelerating climate change. Risks to their production locations, their supply chains, and their demand sides are derived from the same sources of climate change risks that individuals across the country have already experienced: extreme weather events that will grow in intensity and frequency, extraordinary flooding events along rivers and flash flooding in urban areas, extended periods of drought and dangerous wildfires, severe heat waves, and even cold spells, rising seas and coastal storm surge, and the like. Energy companies and power providers have already determined that much of their productive and energy capacity is past its “sell by” date. They know what the Senator does not: for all of these reasons, they agree that last sentences of the first highlighted paragraph authored by Senator Paul are not only **INCORRECT**, they are profoundly misguided.

Senator Paul also enunciated the claim that:

*“the Paris Agreement [is] an agreement which experts believe will not actually solve the environmental issues it was intended to address.”*

The Fawcett diagram and the early paragraphs above show why this, too, is **INCORRECT**.

Lastly, Senator Paul argued that:

*“The federal government should be beholden to one authority and one authority alone—our Constitution—and not some U.N. bureaucrats.”*

The Paris Accord **DOES NO SUCH THING**; it does not make the United States “beholden” to some “U.N. bureaucrats”. Bureaucrats did not craft the Accord and bring it into force on November 4, 2016. Nations did, and 195 signatories certainly hope that the United States keeps its word and continues to play a leading role in confronting the growing climate risks that threaten our common future. The **Constitution** clearly calls, in its very first sentence, that the People of the United States be committed to “promot(ing) the general welfare” – to “provide for the common defense” by protecting ourselves and others by any possible means from unnecessary threats of harm from every source imaginable.