## The Evolving Energy Landscape Five Things Everyone (Including Experts) Should Know About Energy and Climate

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I I July 2023 Amelia Island, Florida













### Background

- I am a professor at the University of Colorado Boulder (2001-) & before that I was a staff scientist at the US National Center for Atmospheric Research (1993-2001)
- I study and write on topics involving contested science, often in highly politicized contexts
- My PhD dissertation (1994) was on how to structure climate science to best support climate policy
- My work was cited in all 3 Working Groups of the recent Intergovernmental Panel on Climate Change AR6 report
- I have testified before the US Congress many times (most recently last month)
- I do my work in public and invite discussion and debate on important issues
- Scientific integrity is always paramount





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Deep decarbonization is widely accepted as a policy goal. Understanding the true scale of the challenge is a necessary first step to developing effective policies.









### Global energy consumption will continue to increase There is no doubt



Global primary energy consumption by energy source (2010–2050) quadrillion British thermal units







Energy consumption in the United States (1776–2022) quadrillion British thermal units









Achieving net-zero carbon dioxide requires achieving netzero fossil fuel consumption – eliminating the unmitigated combustion of coal, natural gas and oil. The challenge is massive, let's look at some numbers.



















It is difficult – and I would say impossible – to make the simple math of decarbonization work without including a massive scale-up of nuclear power









All nuclear waste ever produced would comfortably fit in a football stadium



Source: https://www.linkedin.com/posts/minerdeck\_all-the-spent-fuel-ever-discharged-from-nuclear-activity-7056982990807035904-ORRF



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### Let's do some visual math!









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Alvin W.Vogtle Electric Generating Plant



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# HOW MUCH LAND Does it take to power a city of 1 million?







Source: Bloomberg based on Princeton Net-Zero America Project <u>https://www.bloomberg.com/graphics/2021-energy-land-use-economy/</u>



# **Renewable Rejection Database**



https://robertbryce.com/renewable-rejection-database/





Deep decarbonization will not be achieved by reducing or limiting economic growth. In fact, it can only happen in the presence of growth.

It is an Iron Law.





# Where do emissions come from?

People	Population	Р
Engage in economic activity that	GDP per capita	GDP/P
Uses energy from	Energy intensity of the economy	TE/GDP
Carbon emitting generation	Carbon intensity of energy	C/TE

# The "Kaya Identity"



# What levers do we have to achieve net-zero?

People	Population	Р
Engage in economic activity that	GDP per capita	GDP/P
Uses energy from	Energy intensity of the economy	TE/GDP
Carbon emitting generation	, Carbon intensity of energy	C/TE









"If there is an iron law of climate policy, it is that when policies focused on economic growth confront policies focused on emissions reductions, it is economic growth that will win out every time."







# Example I: Air travel

Passenger air travel by region

### Passenger air travel, select regions

trillion passenger-miles traveled



https://www.eia.gov/outlooks/ieo/



### **Cooling's Rapid Growth**

By 2050, around two-thirds of the world's households could have an air conditioner. China, Indonesia and India will account for half the total number.

### GLOBAL AIR CONDITIONER STOCK



# Example 2: Air Conditioning







# The most used climate scenarios in climate research are out-of-date and portray implausible energy futures







https://www.semanticscholar.org/paper/Title-%3A-A-generic-foresight-process-framework-Year-Voros/ffd5a52cc3dd7e5ed566f5ff199658f3eebca99b



## IPCC First Assessment Report 1990 Scenarios ("Task A") as plausible projections of the future BAU as a "reference scenario" Scenarios B, C, D as "policy scenarios"







# "Emissions scenario" (IPCC 2014)

"A plausible representation of the future development of emissions of substances that are potentially radiatively active (e.g., greenhouse gases, aerosols) based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socioeconomic development, technological change, energy and land use) and their key relationships."





## **Representative Concentration Pathway Scenarios** 4 of the 1,184 IPCC AR5 Scenarios





## **RCPs as radiative forcing pathways** But often forgotten: these RF pathways come from scenarios







Pielke et al. 2022



What happens when we evaluate climate scenarios developed decades ago to assess their plausibility in 2023?







Pielke et al. 2022



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#### Catastrophic climate risks should be neither understated nor overstated

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r contributions: M.G.B., B.P., and J.R. designed research, performed researc

Check for updates



## Climate scenarios are out-of-date. Now what?





# Research emphasizes an implausible scenario

### **Scrutiny for Most Popular Climate Scenario**

Of the four main scenarios designed to run on climate-economic models, the most extreme one draws the most Google Scholar hits.

Hits on Google Scholar for papers citing each warming scenario





### If you read a media report about climate impacts, it is likely that the story is based on RCP 8.5









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### Final thoughts

- Climate change is important
- Climate policies are important
- Energy is essential to humanity thriving on planet Earth & for securing a thriving global environment
- Because of their scale and importance, energy issues usually become deeply politicized
- Pathological politicization begets misinformation



• But the truth is out there!



# Thank You!



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## The Honest Broker Newsletter (please sign up!):

– <u>https://rogerpielkejr.substack.com/</u>



