Mercury Rising

The economic impact of climate change on the Arabian Peninsula

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Above: Dubai,host city for COP28. *Credit the_dead_pixel*

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Summary

This year's COP28 climate summit takes place in one of the world's biggest oil producing regions. Four of the countries from the Arabian Peninsula are among the world's top 10 biggest oil producers (Saudi Arabia, Iraq, the United Arab Emirates and Kuwait).

The impact this oil production has in driving the climate crisis, as one of the three key fossil fuels alongside coal and gas, is well established with 2023 set to become the hottest year in recorded human history. Storms, floods and droughts continue to cause misery across the globe, particularly in the global south.

The 28th COP summit also takes with the hosts, the United Arab Emirates, under pressure to deliver agreement on a fossil fuel phase out date – something they have so far resisted.

Already one of the hottest regions on the planet, new analysis in this report shows that Gulf nations are set to suffer some of the most eyewatering economic impacts from global heating. The nations of the Arabian Peninsula face a median average reduction in GDP growth of up to -68.5% by 2100, with Saudi Arabia and the UAE facing a GDP growth reduction of -72% compared to a scenario where climate change did not occur.

These scenarios are if average global temperature rise reached 3C by 2100. Currently the world is experiencing around 1.4C of warming above industrial levels with many models showing warming of around 3C is likely without much more and much quicker reduction in fossil fuel use.

Even if the world limits warming to around 1.5C by 2100, the countries of the Arabian Peninsula will still suffer considerable loss of GDP growth. The median average GDP growth hit for the region under a 1.5C scenario in 2100 is -36.3%. Saudi Arabia and the UAE will face a reduction in GDP growth of -37.4% and -37.8% respectively.

These figures do not represent a reduction in GDP compared to today but compared to the GDP of these countries in 2100 had climate change not taken place.

"The Stone Age came to an end not because we had lack of stones, and the oil age will come to an end not because we have a lack of oil."

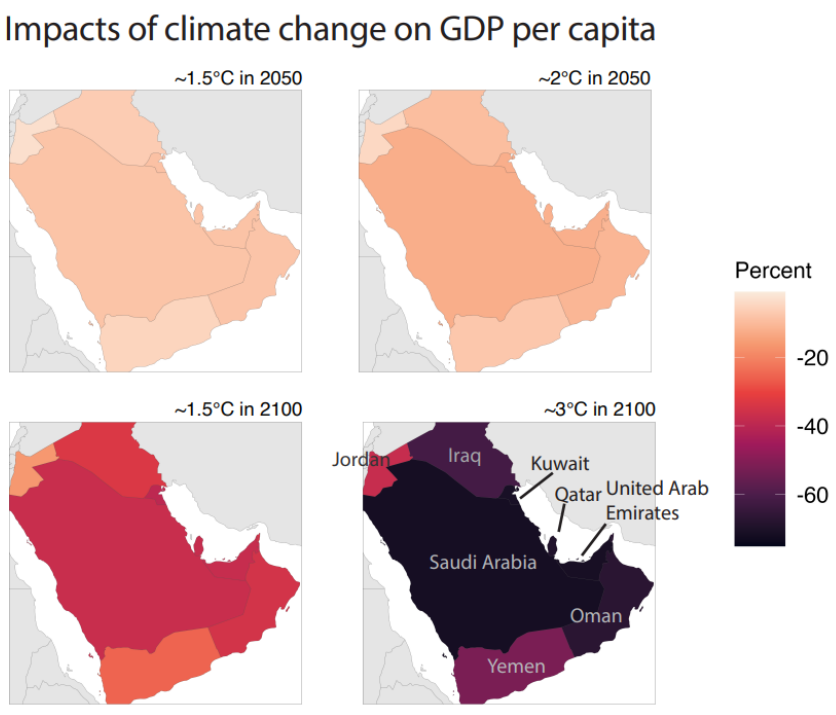
Sheikh Ahmed Zaki Yamani, Former Minister of Petroleum and Mineral Resources of Saudi Arabia -June 2000

A note on methodology

Impacts of climate change on economic performance (here measured by country-level GDP per capita growth projections) were estimated using a two-step modelling procedure proposed by Burke et al. (2015, 2018). The first step estimates a historical relationship between GDP growth and climatic variables, and in the second step this relationship is extended to different temperature pathways over the 21st century to estimate how GDP growth might be affected by climate change (See Appendix for a full methodology). This study covers all the countries of the Arabian Peninsula except Bahrain, for which the relevant data was not available. The countries covered therefore include the United Arab Emirates, Saudi Arabia, Kuwait, Qatar, Oman, Iraq, Jordan and Yemen.

Our estimates are modelled projections which naturally have some limitations. The data assumes countries undertake no adaptation, so where adaptation happens, a reduction in the economic damage estimates is expected. However adaptation cannot be taken for granted, especially in poorer countries. Neither does the data project the impacts of individual extreme weather events. Therefore, even these drastic projections are likely to be an underestimate given the impact of more frequent and acute weather events.

The economic threat to the Arabian Peninsula



Authors' calculations based on Burke et al. 2018

These findings show how the Gulf nations will face severe economic pain, not only in 2100 but as soon as 2050.

If the world limits global heating to 1.5C by 2050, the economic harm to the region will be 'limited' to a median average of -8.2% reduction in GDP growth. If global heating reaches 2C by 2050, the average GDP growth hit for the region will be -11.5%.

The below table shows the cumulative economic cost of climate change, even if temperature increase is stabilised. While a 1.5C world in 2050 faces a smaller but still significant impact, if the world continues to suffer through that level of global heating up until 2100 the economic pain will be substantial, even if the temperature rise kept in check. This is because the economic harm builds over time, even if the temperature doesn't rise beyond 1.5C.

Percentage impact on GDP growth based on different global temperature scenarios					
Country	1.5C by 2050	2C by 2050	1.5C by 2100	3C by 2100	CO2 emissions per capita (2022, tonnes)
Saudi Arabia	-8.4	-12.5	-37.4	-72	18.2
UAE	-8.5	-12.2	-37.8	-71.6	25.8
Kuwait	-8.8	-12.4	-39.7	-71.2	25.6
Qatar	-8.1	-11.9	-37.3	-69.6	37.6
Oman	-8.3	-10.9	-35.2	-67.3	15.7
Iraq	-6.8	-9.5	-33.5	-62	4
Yemen	-5.2	-7.7	-25.5	-52.1	0.3
Jordan	-3.2	-4.5	-16.6	-37.7	2

Heat record

The Arabian Peninsula can already claim to be one of the hottest places on the planet, even at just 1.4C of global warming. The hottest temperature ever recorded on earth is technically 56.7C in Death Valley, USA, on 10 July 1913. However, doubt has been cast on the veracity of that recording. If that is declassified the hottest temperature record would belong jointly at 54C to Mitribah in Kuwait on 21 July 2016 and 54C in Death Valley on 20 June 2013.[1]

Oil country

It is noteworthy that many of the countries of the Arabian Peninsula are some of the world's biggest producers of oil and gas and so bare some of the responsibility for the climate crisis being unleashed around the world.

The per capita emissions of these nations are some of the highest on the planet. COP28 hosts UAE produce 25.8 tonnes of CO2 per person. The average person in the Democratic Republic of the Congo produces 0.04 tonnes, meaning the average Emirati is responsible for the same carbon emissions as 645 Congolese.[2] And these figures are just the consumption emissions of the average person, they don't even take into account the huge emissions caused by the oil and gas traded by the UAE and other Gulf nations.

Above: COP28 gets underway in Dubai. *Credit: UNclimatechange*

Recommendations

Fossil fuel phase out

Climate vulnerable countries have been calling for a phase out date for fossil fuels for many years as these fuels account for more than 75% of all greenhouse gas emissions.[3]

Already more than 100 countries are in favour of this move and came close to securing it at COP27 in Egypt in 2022. With 2023 on record as being the hottest year ever recorded and climate suffering continuing around the world, COP28 would be the ideal place for this phase out date to be set.

Although Gulf nations have opposed this move, this report shows they face a future of economic hardship if they, and the world, doesn't stop burning fossil fuels.

Triple renewables

The world needs to ramp up clean energy provision. Some countries are already making great strides. Kenya has renewables making up 90% of its electricity mix and plans to be 100% by 2030.[4] We need to see countries at COP28 committing to a trebling of renewable capacity and a doubling of energy efficiency to reduce the need for fossil fuels.

Invest in the just energy transition

Developing countries often don't have the funds and capacity to transition their energy systems at speed, which is why the world needs richer countries to increase investment in clean energy around the world, share the latest technology and boost skills and green jobs in the global south.

Appendix: Methodology

Impacts of climate change on economic performance (here measured by country-level GDP per capita) were estimated using a two-step modelling procedure proposed by Burke et al. (2015, 2018). The first step estimates a historical relationship between GDP growth and climatic variables, and in the second step this relationship is extended to different temperature pathways over the 21st century to estimate how GDP growth might be affected by climate change.

There is no consensus so far in economics and statistics on the "right" theoretical approach to estimate economic damages of climate change and the numbers vary widely depending on the initial specification and the modelling approach. One of the most prominent sources of differences stems from the choice between estimating damage to the level of output in an economy (i.e., impact on GDP in a single year or at a point in time) or whether it impacts economic growth (i.e., impact on GDP growth via damages to natural and human capital, under-investment, etc.). Resulting estimates from the two approaches vary primarily because the growth effects accumulate over time and are, by definition, substantially larger than level effects. Growth based effects from prominent global assessments based on top-down econometrics vary between 7% (Kahn et al. 2019) and 23% (Burke et al. 2015) globally, while the level-based effects are centered around 1-2% of GDP reduction globally (Newell et al., 2021).

The analysis here is based on an econometric approach proposed in prominent papers of Marshall Burke and colleagues published in Nature magazine in 2015 and 2018.

Historical relationship between per capita GDP growth, temperature and precipitation is estimated using a fixed effects model with the following equation:

$$\Delta \ln(GDP_{i,t}) = \beta_1 T_{it} + \beta_2 T_{it}^2 + \beta_3 P_{it} + \beta_4 P_{it}^2 + \mu_i + \upsilon_t + \theta_{1i}\, t + \theta_{2i}\, t^2 + \varepsilon_{it}$$

where the dependent variable is GDP growth of country i in year t, T and P are the average temperature and precipitation in year t, μ_i represents country-fixed effects that control for heterogeneity between countries that do not vary over time (e.g. historical legacy, institutions or culture), υ_t are year-fixed effects that account for common global shocks in a given year (e.g. financial crisis), and θ_1i t + θ_2i t^2 are country-specific linear and quadratic time trends, which allow GDP and temperature to evolve flexibly (e.g. account for positive growth trends of both variables without confounding the relationship). Inclusion of the three types of fixed effects means that the estimated coefficients β_1 - β_4 can be interpreted as actual impacts of temperature and precipitation that are independent of non-climate related confounding factors. Only temperature variable (coefficients β_1 and β_2) is statistically significant in different specifications tested and this relationship holds robustly across alternative models. The non-linear (quadratic) relationship between GDP and climate variables allows the effect of warming to differ depending on the country's average temperature.

Several bootstrapping techniques (by country; by year; by five-year blocks) have been used to quantify uncertainty in coefficient estimates β_1 and β_2. Bootstrapping uses different sampling methods to derive improved estimates of standard errors and confidence intervals.

Future GDP growth in the climate change scenarios is compared to the "baseline" scenarios available from the socio-economic scenario framework – the Shared Socioeconomic Pathways (SSPs) (O'Neill et al. 2017) – which are the basis for climate impact assessments in the 6th Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC). The SSPs are meant to represent a range of plausible futures of socio-economic components in a hypothetical world without climate change. They are used as baselines in comparisons to scenarios with climate change. Here we use the SSP1 scenario which is meant to be most compatible with the 1.5°C-consistent pathway. Baseline SSP scenarios can also be explored here.

Caveats:

Estimates presented here are based on an econometric model that is based on the relationship between GDP growth and temperature, without accounting for the possible impacts of extreme events. Incorporating climate extremes such as droughts, floods or storms could have a substantial impact on economic performance. Recent advances in damage estimates that include extreme events are significantly larger than the ones who do not, implying that the optimal temperature pathways are the ones that limit global warming in line with the Paris Agreement (Piontek et al., 2021). Additionally, it is useful to keep in mind that adaptation measures which could potentially alleviate some of the damage are not incorporated here either.

Endnotes

1 https://en.wikipedia.org/wiki/Highest_temperature_recorded_on_Earth

2 https://ourworldindata.org/grapher/co-emissions-per-capita

3 https://www.un.org/en/climatechange/science/causes-effects-climate-change

4 https://www.statista.com/statistics/12765 47/share-of-renewables-in-electricity-generation-in-kenya