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and Mineral Law and Policy
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Moving Beyond Oil and Gas: What can we learn from States in the Commonwealth?

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October 2021

Supported by

RSE
The Royal Society of Edinburgh
KNOWLEDGE MADE USEFUL

Contents

Executive Summary

It has long been understood that the climate crisis has different implications for low and medium-income countries than for others. Within this grouping of more than a hundred independent states, many for whom any transition beyond fossil fuels will be very difficult. This Research Insight focuses on one group of states that are committed to making commitments under the Paris Agreement and which have a history of cooperation, loosely as members of the Commonwealth, and asks if there are lessons to be learned from their initial steps to move beyond oil and gas dependence. If there are, they could be given some support from within that grouping of states.

Out of 54 states that are members of the Commonwealth, no less than 23 have a material stake in oil and gas development. A few of these are high-income states, while most fall into the other categories. Petroleum remains a key driver of broader economic development in this group, with export success dependent upon available geology, the level of international prices obtained in the marketplace, geographical location and quality of governance. Each of these states is now constructing a pathway to an energy transition that reflects its own circumstances.

This Research Insight examines five states within this grouping of petroleum-dependent states, each with widely different economic circumstances but committed to making Nationally Determined Contributions (NDCs) under the Paris Agreement. All five – Bangladesh, Cameroon, Pakistan, Trinidad and Tobago, and the UK - are heavily reliant on fossil fuels for the majority of their current energy needs.

Our general findings show:

- a reluctance to divest from fossil fuels, with governments citing their varying energy demands, development needs, and capabilities;
- the importance of nuclear energy as a possible part of the solution among several states that have embarked on measures of ‘energy transition’. Of the five case study countries, a majority (namely the UK, Pakistan and Bangladesh) all have either existing or planned electricity capacity from nuclear generation; in the case of both the UK and Pakistan, this is from their existing, and producing, civil nuclear fleet;
- a broad acceptance of a transition to renewable energy in terms of policy commitment, alongside a revealed developing world policy choice, amongst the case studies examined, to both increase their levels of petroleum extraction where possible, and to continue to utilise natural gas domestically; and
- without sufficient, timely, financial support and technical advice, states in this grouping are unlikely to make significant progress in a transition from hydrocarbons as a vehicle for economic growth to one that is sustainable and fair.

Introduction: The Clock Ticks Ever More Loudly

Anthropogenic climate change is an existential threat to humanity. What will our response be? This Research Insight examines that challenge through the lens of the Commonwealth, "a voluntary association of independent and equal sovereign states" [1] with a total population of 2.5 billion people across 19 countries in Africa, 13 in the Caribbean and the Americas, 11 in Eurasia, 11 in the Pacific, and 54 countries in total.[2] Collectively, its member states "aspire to a Commonwealth that is a strong and respected voice in the world, speaking out on major issues."[3]

In a Climate Change Declaration, the Commonwealth Heads of Government stated: "we represent a third of the world's population in all continents and oceans, and more than a quarter of the parties to the UNFCCC (United Nations Framework Convention on Climate Change). We have the global reach and diversity to help forge the inclusive global solutions needed to combat climate change."[4]

The United Kingdom (UK) is also the host for the 26th UN Climate Change Conference (COP-26), in November 2021, in which all Commonwealth countries are participants. UK government minister Alok Sharma MP, President for COP 26, is clear about the urgency of the crisis: "I don't think we're out of time, but I think we're getting dangerously close to when we might be out of time."[5]

According to one prominent report (2021) "the challenge is to close the gap between rhetoric and action in four ways," [6] summarised here as: (1) ambitious deliverables, actually delivered; (2) a climate-compatible pathway that also supports economic growth; (3) can-do, mobilised, climate politics; and (4) both public and private sector energies unleashed for change.

What does this challenge look like in the specific context of the 23 Commonwealth petroleum-producing countries? The states (listed as Annex 1, below) include both existing producers and those countries with a declaration of commerciality and/or a Final Investment Decision (FID) already in place. The latter will join the next generation

[1] Commonwealth, 'Commonwealth Charter' (*The Commonwealth,* 2013) <https://thecommonwealth.org/about-us/charter> accessed 25-Sep-2021
[2] Commonwealth, 'Fast Facts' (*The Commonwealth,* 2021) <https://thecommonwealth.org/commonwealth-fast-facts> accessed 25-Sep-2021
[3] Commonwealth, 'Commonwealth Charter'
[4] Commonwealth, *The Commonwealth Climate Change Declaration* (The Commonwealth 2009)
[5] Tess de La Mare, 'Sharma in stark warning over consequences of failing to tackle climate change' (*Evening Standard,* 2021) <https://www.standard.co.uk/news/uk/alok-sharma-cop26-glasgow-government-guardian-b949670.html> accessed 25-Sep-2021
[6] Phil Mcnally; and Tim Lord, *Mind the Gap: Success at COP26* (Tony Blair Institute for Global Change 2021)

of petroleum-producing states. Annex 2 provides a summary of the Paris Agreement (2015) COP-21 NDCs of each of these states. For example, Commonwealth state Nigeria has included an NDC committing it to drastically reducing, by as much as 60%, fugitive methane (natural gas) emissions by 2031[7] and ending all gas flaring by 2030.[8]

Anatomy of the Challenge

The Paris Agreement "entered into force on 4 November 2016. Its goal is to limit global warming to well below 2 degrees Celsius, and preferably to 1.5 degrees Celsius, compared to pre-industrial levels."[9]

Writing in the journal *Nature,* Welsby, D. *and others*. (2021) provide global[10] quantitative non-extraction (by 2050) estimates for coal, oil and natural gas reserves (all as at 2018) that must be achieved if the world is to have a fifty per cent chance of not exceeding a 1.5 °C global increase in temperatures.[11] Globally, these targets are as follows: 58% of oil, 59% of natural gas and 89% of coal reserves should be left unextracted. The authors of this paper note the very close similarity of the targets for oil and natural gas.[12]

The energy sector is the source of around three-quarters of GHG emissions,[13] and it is these emissions that drive anthropogenic climate change. The destructive impact of climate change is already evident, notably through increasingly frequent and common extreme weather events. As we approach 1.2°C warming since the start of the Industrial Revolution, a global 1.5°C increase is now seen as the minimum that we will experience.

Should the increase reach above a certain level, then positive feedback mechanisms will be triggered with respect to yet more rises in global temperatures, perhaps irreversibly. The exact level of temperature rise that would breach the requisite "planetary threshold" to be breached, constituting a climate change global "tipping

[7] Alfredo Miranda-González; and Jonathan Banks, 'Nigeria Shows its Commitment to Cutting Methane Pollution' (*Clean Air Task Force,* 2021) <https://www.catf.us/2021/08/methane-pollution-nigeria-ndc/> accessed 25-Sep-2021

[8] Joe Lo, 'Nigeria to end gas flaring by 2030, under national climate plan' (*Climate Home News,* 2021) <https://www.climatechangenews.com/2021/08/13/nigeria-end-gas-flaring-2030-national-climate-plan/> accessed 25-Sep-2021

[9] United Nations, *The Paris Agreement* (UN 2015).

[10] And also regional targets too, but since Commonwealth member states are to be found in every continent and region of the world bar Antarctica, this paper references the global targets provided rather than regional ones – the calibration of which may additionally be politically contentious and contested.

[11] Dan Welsby and others, 'Unextractable fossil fuels in a 1.5° C world' (2021) 597 Nature 230

[12] Noting that the 2015 IEA report "World Energy Outlook 2015" quotes similar targets of 80% non-extraction for coal, 50% for oil and 40% for natural gas, i.e. whilst there is a gap (10%) between natural gas and oil targets, this is just one third of the gap (30%) between oil and coal.

[13] Dr Carole Nakhle, 'The energy transition: Some inconvenient truths' (*Crystol,* 2021) <https://www.crystolenergy.com/the-energy-transition-some-inconvenient-truths/> accessed 25-Sep-2021

point"[14], is intensely debated and remains uncertain,[15] but is the subject of ongoing research, for instance by Lade *and others.* (2018).[16] However, what is clear is that the threat is extremely serious; as per Article 3 of the UNFCCC, which states that "parties should take precautionary measures to anticipate, prevent, or minimize the causes of climate change and mitigate its adverse effects,".[17] We may apply this principle to the "exact point at which positive feedback mechanisms become irresistible,"[18] and therefore agree with Lade *and others.* (2018),[19] when they "suggest 2 °C because of the risk that a 2 °C warming could activate important tipping elements (12[20], 17[21]), raising the temperature further to activate other tipping elements in a domino-like cascade that could take the Earth System to even higher temperatures." An upper limit of 2 °C is also as specified in the COP-21 Paris Agreement (2015) as a figure for which the world needs to keep global temperatures "well below", with best efforts targeted at making 1.5 °C the actual ceiling.[22]

For fossil fuel consuming and utilising countries around the world, this presents a huge challenge. Specifically for Commonwealth upstream petroleum countries (listed at Annex 1, below), the required energy transition away from fossil fuels, not least oil and gas, presents both an opportunity and a threat, as noted by David Manley (2021): "while the rise of renewable energy and other low carbon technologies may steer the world away from the worst effects of climate change, for a group of countries low-carbon technologies (also) pose an economic threat to address."[23]

What then can a deep dive into the data, behaviour and stated intentions of Commonwealth countries reveal about where they, and by extension, the world, is heading in its climate response? Since the grouping of states we are considering are all engaged in the exploration and production of petroleum, we may ask whether there is a detectable decline in the sector. Is the end to oil and gas development on the horizon, or does that prospect remain (for some at least) wishful thinking?

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[14] Will Steffen and others, 'Trajectories of the Earth System in the Anthropocene' (2018) 115 Proceedings of the National Academy of Sciences 8252

[15] Ibid.

[16] Steven J Lade and others, 'Analytically tractable climate–carbon cycle feedbacks under 21st century anthropogenic forcing' (2018) 9 Earth System Dynamics 507

[17] United Nations, *United Nations Framework Convention on Climate Change* (UN 1992)

[18] Steffen and others, 'Trajectories of the Earth System in the Anthropocene'

[19] Ibid

[20] Hans Joachim Schellnhuber, Stefan Rahmstorf and Ricarda Winkelmann, 'Why the right climate target was agreed in Paris' (2016) 6 Nature Climate Change 649

[21] Timothy M Lenton and others, 'Tipping elements in the Earth's climate system' (2008) 105 Proceedings of the national Academy of Sciences 1786

[22] United Nations, *The Paris Agreement*

[23]David Manley and others, 'Oil-rich Countries' Responses to Energy Transition: Managing the Decline' in Peter Cameron and others (ed), *The Global Energy Transition: Law, Policy and Economics for Energy in the 21st Century* (Bloomsbury 2020), p.25

Of the two forms of petroleum, natural gas is preferable to oil in climate terms since it emits far lower levels of GHGs, and is hence considered by some commentators and advocates a "transition fuel", a claim critically analysed by Gürsan and de Gooyert (2021).[24]

Focusing on results rather than aspirations, an explicit policy in favour of natural gas development (such as in Bangladesh, a case study below) and use is preferable to one that, on paper, is focused solely on renewable energy but, *de facto,* maintains alongside a reliance on coal-fired power. An observation made of Germany's "*Energiewende*" or energy transition, reminds us: "coal-fired power generation, now (July 2020) meeting almost half of the load with substantial carbon dioxide output, is allowed to continue (in Germany) but is expected to diminish significantly by 2030."[25]

Yemi Osinbajo, Vice President (VP) of Commonwealth member state Nigeria, has commented (2021)[26] on what he sees as the frequent lack of real-world pragmatism with respect to natural gas investments: this leads to natural gas often being treated by policymakers in the same way as fossil fuel sources, oil and coal, despite its much lower levels of GHG emissions:

> *"after decades of profiting from oil & gas, a growing number of wealthy nations have banned or restricted public investment in fossil fuels, including natural gas. Such policies often do not distinguish between different kinds of fuels."*

Natural gas is a significant fuel for domestic consumption in all five of the Commonwealth case studies below. In all bar one (Bangladesh), production of the fuel is significant to the economy too, with extraction rents in 2019 accounting for between 0.5% of GDP, in Pakistan and the UK, upwards to 2.8%, in Cameroon, and finally 3.3% of Trinidad and Tobago's GDP.[27] Whilst the prognosis of any imminent end to oil may be a challenging conclusion to maintain, any such prognosis for natural gas is likely to be even further off, despite some investors choosing divestment from natural gas projects alongside those of coal and oil.

These prognoses are examined below through Commonwealth members state case studies in Eurasia (Bangladesh, Pakistan, and the UK), the Caribbean (Trinidad and Tobago) and Africa (Cameroon).

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[24] C. Gürsan and V. de Gooyert, 'The systemic impact of a transition fuel: Does natural gas help or hinder the energy transition?' (2021) 138 Renewable and Sustainable Energy Reviews 110552

[25] World Nuclear Association, 'Germany's Energiewende' (*WNA,* 2020) <https://world-nuclear.org/information-library/energy-and-the-environment/energiewende.aspx> accessed 25-Sep-2021

[26] Foreign Affairs 'The Divestment Delusion, Why Banning Fossil Fuel Investments Would Crush Africa' (*FA,* 2021) < https://www.foreignaffairs.com/articles/africa/2021-08-31/divestment-delusion> accessed 13-Nov-2021

[27] World Bank, 'Natural Gas Rent (% of GDP)' (World Bank, 2021) <https://data.worldbank.org/indicator/NY.GDP.NGAS.RT.ZS> accessed 25-Sep-2021

Case Study 1 – UK

UK – Climate Action Delivery

The UK has benefited from its upstream petroleum sector over many decades and has a long and distinguished coal mining history. While benefiting from the extraction of these fossil fuels over time, the UK is now at the forefront of action on climate change and is the host of the 26th COP (COP-26), taking place in Glasgow in November 2021. In October 2021, the UK Government committed to a "Net Zero Strategy: Build Back Greener" for the achievement of net-zero GHG[28] emissions by the target date of 2050.[29]

The UK's NDC, as updated in December 2020 and replacing its joint 2015 declaration as part of the European Union (EU), commits the country to reduce economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels (see Annex 2 for further details).

The latest figures on coal mining and energy use illustrate that a country such as the UK can move away from a fossil fuel that used to be so central to it both economically and socially: in the first quarter of 2021, demand for coal fell below 1m tonnes, 30% lower than in the same period in 2020, and coal production was 53% lower for the same time period, at 259,000 tonnes.[30]

In stark contrast, in 1913, UK production peaked at 287million (m) tonnes, with employment peaking eight years later at 1.25m;[31] and in terms of consumption, coal accounted for fully one-quarter of UK electricity generation as recently as 2015, compared to 1.6% in 2020.[32]

Despite the Covid-19 interruption, the UK's economy continues to grow. Even as it does so, its CO_2 emissions are falling, and this is true of both its territorial emissions (i.e. within the UK's borders) and consumption emissions (i.e. including emissions embodied in the goods consumed in the UK).

[28] GHG emissions measured, for instance, as carbon dioxide equivalents (not just CO_2)
[29] HM Government, *Net Zero Strategy: Build Back Greener* (UK Government 2021)
[30] Department of Business Energy and Industrial Strategy, *Statistical Release - Energy Trends (January to March 2021)* (UK Government 2021)
[31] The Coal Authority, '200 years of the coal industry in Britain' (*CA,* 2021) <https://www2.groundstability.com/history-of-coal-mining-timeline-page/> accessed 25-Sep-2021
[32] Edie Newsroom, 'UK's coal power spikes amid cold snap, despite 'greenest year on record' for electricity in 2020' (*Edie,* 2021) <https://www.edie.net/news/10/UK-s-coal-power-spikes-amid-cold-snap--despite--greenest-year-on-record--for-electricity-in-2020/> accessed 25-Sep-2021

The UK is one of 32 countries with populations of at least 1m, real Gross Domestic Product (GDP) growth,[33] and falling emissions of both types specified above.[34] Of this select group of countries, it is ranked[35] in second place, directly behind Denmark. This "absolute decoupling"[36] namely, of CO_2 emissions and real GDP growth achieved by the country provides, alongside the other 31 countries also listed, a pathway for other countries striving to reduce their own CO_2 whilst still achieving economic growth. Cyprus and Jamaica, both fellow member states of the Commonwealth, also achieved this absolute decoupling.

Emulation of this achievement among other Commonwealth states would greatly assist in the collective struggle to achieve efficacious climate action globally before it is too late. Notably, all three Commonwealth countries named above have achieved this absolute decoupling either as a petroleum-producing country (the UK), the post-commercial discovery of natural gas (Cyprus, the NDC of which is the most recent joint EU one)[37], or whilst actively pursuing upstream exploration for oil and gas, in the case of Jamaica.[38]

This all remains the case despite ongoing upstream petroleum development in the UK. It shows how a climate-compatible pathway that also supports economic growth is possible, one of the challenges and benchmarks set out initially in this paper.

UK – No End to Oil and Gas Yet

A clear lesson of the UK over many years and decades is not to predict the 'end' of oil or gas too early, even when the herd instinct amongst commentators – something that has happened regarding UK production frequently and well before any broad awareness of climate change as a scientific fact became an urgent public policy issue – seems to be to do so.

The UK's petroleum production profile has long since been considered to be in long-term and precipitous decline due to its main North Sea petroleum basin reaching 'mature' status, although production levels have recently plateaued (see below). The following graph illustrates the point with respect to oil recovery for both the UK and

[33] Real GDP increase as measured on a purchasing power parity basis, using constant 2017 international $USD.
[34] Zeke Hausfather, 'Absolute Decoupling of Economic Growth and Emissions in 32 Countries' (*The Breakthrough Institute,* 2021) <https://thebreakthrough.org/issues/energy/absolute-decoupling-of-economic-growth-and-emissions-in-32-countries> accessed 25-Sep-2021
[35] in terms of territorial CO_2 reduction
[36] Zeke Hausfather, 'Absolute Decoupling of Economic Growth and Emissions in 32 Countries'
[37] Offshore Energy, 'Aphrodite gas discovery declared commercial (Cyprus)' (*OE,* 2021) <https://www.offshore-energy.biz/aphrodite-gas-discovery-declared-commercial-cyprus/> accessed 25-Sep-2021
[38] Latonya Linton, 'Oil And Gas Exploration Continues' (*Jamaica Information Service,* 2021) <https://jis.gov.jm/oil-and-gas-exploration-continues/> accessed 25-Sep-2021

Norway, with which it shares an almost equal amount of the North Sea basin's petroleum reserves)[39], as per Figure 1 below:

Figure 1

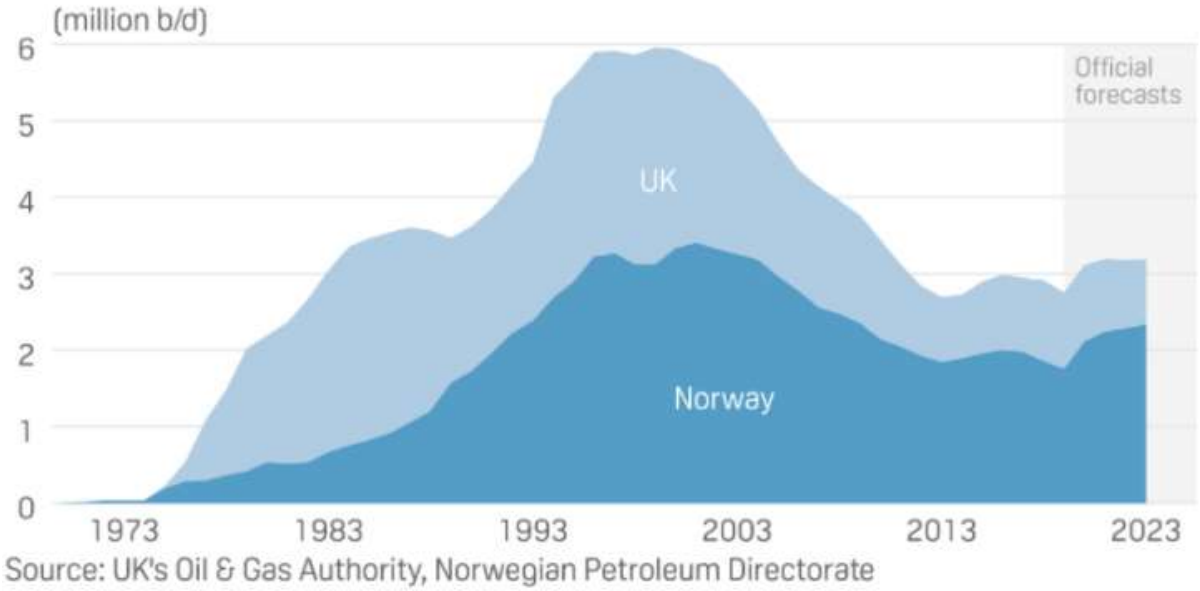


Image credit: S&P Global Platts[40]; 'b/d' = barrels of oil equivalent per day extracted.

In the case of the UK, the resilience of upstream petroleum extraction can also, in part, be credited to the government policy of "Maximising Economic Recovery" (MER) of UK petroleum, pursuant to section 9A(1) of the UK's Petroleum Act 1998, including by requiring upstream operators to collaborate with one another and with the state to achieve that objective.

The longevity of the UK's petroleum sector has confounded its doubters throughout almost its entire history, with predictions made frequently that the UK's North Sea oil basin was in significant decline, and would soon 'run out of oil', and that now was the time to begin large-scale decommissioning work.

Instead, a combination of technological innovation, entrepreneurship and intermittent and unpredictable periods of high prices have provided a boost to both investors and the North Sea's proven levels of reserves (since that definition is dependent upon price, i.e. reserves are resources that it is economic to extract at any given price), have combined to ensure it remains resolutely still in production and shows no signs of termination in the foreseeable future.

[39] Nick Coleman; Richard Rubin, 'North Sea industry faces new pressures over climate, resource shortfall' (*S& P Global Platts,* 2020) <https://www.spglobal.com/platts/en/market-insights/latest-news/oil/010720-commodities-2020-north-sea-industry-faces-new-pressures-over-climate-resource-shortfall> accessed 25-Sep-2021

[40] Ibid.

Pro-active public policy is a longstanding characteristic of the UK's upstream petroleum sector, and MER has evolved to co-exist with climate change policies developed for the management of the UK part of the North Sea oil and gas basin, notably the:

- North Sea Transition Deal[41], under which operators commit to cut GHG emissions from upstream operations, from a current annual total of approximately 18.5 metric tonnes p.a. to Net Zero Emissions (NZE) by 2050; and
- "Central Obligation" of the revised Oil & Gas Authority Strategy,[42] which came into effect on 11 February 2021[43], and that requires both:
    - "relevant persons must… , take the steps necessary to" deliver MER (specifically: activities "optimal for maximising the net value of economically recoverable petroleum that can be recovered under the licence"); whilst also
    - "tak(ing) appropriate steps to assist the Secretary of State in meeting the net-zero target, including by reducing as far as reasonable in the circumstances GHG emissions from sources such as flaring and venting and power generation, and supporting carbon capture and storage projects."

UK – Relatively Climate Resilient

The resilience of the UK's petroleum sector is matched by its estimated resilience to climate change, as measured by the European Investment Bank (EIB)'s Physical Risk rating scale.

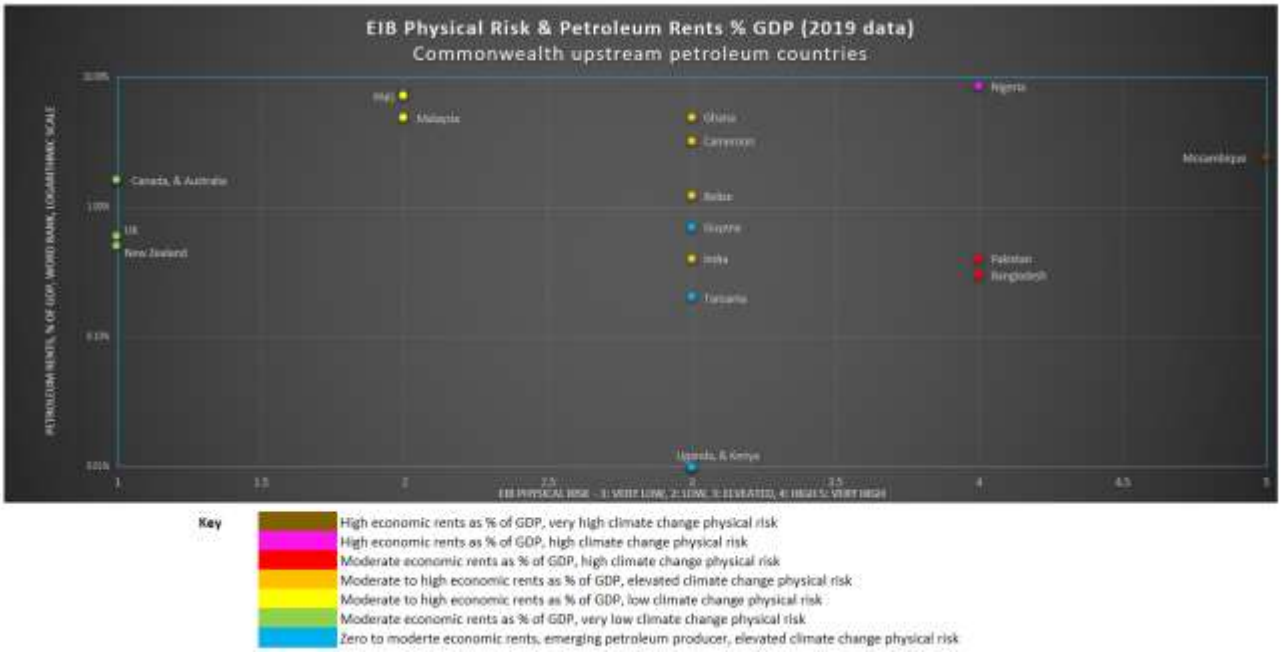
The EIB's Physical Risk rating relates to the direct exposure threat – "in particular to acute events, rising sea levels and excessive heat" [44] – of climate change, to each named country. Figure 2, below, describes this risk rating, for those Commonwealth upstream petroleum countries where the relevant EIB data is available and including the UK, alongside their level of petroleum rents[45], measured as a percentage of Gross Domestic Product (GDP), and utilising a logarithmic scale.

As shown in Figure 2 below, the UK is one of many developed Commonwealth countries with moderate levels of petroleum rents and Very Low (1) levels of climate change Physical Risk. It illustrates the comparatively resilient situation of the country, alongside New Zealand, Canada and Australia, which are all similarly situated, to

[41] UK Department of Business Energy and Industrial Strategy, *North Sea Transition Deal* (UK Government 2021)
[42] Oil and Gas Authority, *The OGA Strategy* (OGA 2021) 6
[43] Oil and Gas Authority, 'Notice (Section 9G of the Petroleum Act 1998)' (*OGA,* 2021) <https://www.ogauthority.co.uk/media/7039/oga-strategy-notice-february-2021.pdf> accessed 25-Sep-2021
[44] European Investment Bank, *Assessing climate change risks at the country level: the EIB scoring model* (EIB 2021)
[45] Petroleum rents are defined herein as the difference between the value of petroleum production at world prices and total costs of their production.

climate change plus – and this applies to all of those countries – the fact that the UK is not overly dependent upon the petroleum sector economically.

Figure 2



UK – Summary

In summary, the UK is one of the Commonwealth's most climate-insulated member states and one of its leaders in climate action. It provides a stand-out case study of upstream petroleum longevity and resilience, not termination, consistent with the challenge, numbers (2) above, of a climate-compatible pathway that also supports economic growth.

Case Study 2 – Bangladesh

Bangladesh – From Coal to (mainly) Natural Gas

A second Commonwealth country that has proven resolute in its upstream petroleum production is Bangladesh; its natural gas production has steadily increased from under 18,000mn m^3 in 2008 to over 28,000mn m^3 in 2019.[46]

To paraphrase from BP's marketing and communications campaign that its chief executive initiated in 2002,[47] Bangladesh is not seeking to go 'Beyond Petroleum' yet, probably 'Beyond Coal' would be more accurate (see below).

The longevity of coal in the energy mixes of both developing and developed countries should perhaps not surprise us: "past energy transitions have been slow, e.g. it took over 100 years for oil to replace coal as the dominant form of energy (and)… past transitions did not result in the complete replacement of the old energy source."[48]

However, in a part of the world where coal remains so important, Bangladesh is leading the way in its transition away from the heavily GHG-emitting fuel. In July 2021, the country announced the cancellation of ten planned coal-fired power stations and *c.*8,711 megawatts (MW) of planned installed capacity. This is despite having sourced international finance for the development of half of them, specifically: "two of the cancelled plants had been backed by Chinese funds, while others had investors from Japan, Singapore and Malaysia."[49] The reasons given by Bangladesh's State Minister for Power, Energy and Mineral Resources, Nasrul Hamid MP, for these cancellations included both their slow rate of implementation and their negative environmental impact.[50]

Instead, Bangladesh has made natural gas production and utilisation a national and strategic priority. Strikingly, further to the cancellation of the above ten coal-fired power plants, Bangladesh's government stated that it would consider which of these projects could be converted to alternative fuel(s), with natural gas the alternative suggested by the above Ministry.[51]

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[46] CEIC, 'Bangladesh Natural Gas Production: OPEC: Marketed Production' (*CEIC,* 2019) <https://www.ceicdata.com/en/indicator/bangladesh/natural-gas-production-opec-marketed-production> accessed 25-Sep-2021

[47] Scott Carpenter, 'After Abandoned 'Beyond Petroleum' Re-brand, BP's New Renewables Push Has Teeth' (*Forbes,* 2020) <https://www.forbes.com/sites/scottcarpenter/2020/08/04/bps-new-renewables-push-redolent-of-abandoned-beyond-petroleum-rebrand/?sh=78494fbf1ceb> accessed 25-Sep-2021

[48] David Manley and others, 'Oil-rich Countries' Responses to Energy Transition: Managing the Decline', 33

[49] Syful Islam, 'Bangladesh scraps plans for 10 coal-fired power plants' (*Nikkei Asia,* 2021) < https://asia.nikkei.com/Politics/International-relations/Bangladesh-scraps-plans-for-10-coal-fired-power-plants> accessed 20-Oct-2021

[50] Ibid

[51] Ibid

Indeed, natural gas is increasingly central to Bangladesh's development success story: "natural gas development helped fuel spectacular growth in (Bangladesh's) food production… Investments in natural gas production for domestic development, fertilizer, water, and power allowed Bangladesh to become self-sufficient in food and a significant exporter of textiles, apparel, and leather products. Today, natural gas constitutes over 60 percent of the country's primary energy."[52]

Bangladesh – From "Basket Case to Beacon"

Impressively, Bangladesh moved from being one of the world's poorest nations in 1971, with the tenth lowest per capita GDP globally, to lower-middle-income status in 2015[53]. The above quote, "Basket Case to Beacon", is the title of Joyashree Roy's 2021 article that she subtitled "How Bangladesh Transformed Itself into a Modern and Resilient Society."[54] During that time period, electricity interconnection was achieved in 1982 between the more heavily populated east of the country, and the west of Bangladesh, beyond the broad Jamuna River; this connected the western region, which generates just *c.*22% of Bangladesh's electricity, with the east, dominant not just in power generation but also consumption, including the capital Dhaka at *c.*50% of total national electricity usage.[55]

Looking ahead, the World Bank notes that the country's development pathway would result, all other things being equal, in it being removed from the United Nations' list of Least Developed Countries (LDCs) in 2026.[56]

Bangladesh's economic growth is attributable to government policies and initiatives, including with respect to the power and petroleum sectors, but also regarding key infrastructure development. A prime example is the 4.8-kilometre-long Bangabandhu Jamuna Multipurpose Bridge, the longest in South Asia, spanning the world's fifth-largest river, the Jamuna. Bangladesh's eastern and western parts are divided by that river, dividing the country's roadways and railways and its population down to the Bay of Bengal.[57] Construction of the bridge began in 1994 and took nearly four years to

[52] Joyashree Roy, 'Basket Case to Beacon, How Bangladesh Transformed Itself into a Modern and Resilient Society' <https://thebreakthrough.org/journal/no-14-summer-2021/bangladesh-energy-beacon> accessed 20-Oct-2021

[53] The World Bank, 'The World Bank In Bangladesh', (2021). [online] Available at: <https://www.worldbank.org/en/country/bangladesh/overview#1> [Accessed 18 October 2021].

[54] Joyashree Roy, 'Basket Case to Beacon, How Bangladesh Transformed Itself into a Modern and Resilient Society' <https://thebreakthrough.org/journal/no-14-summer-2021/bangladesh-energy-beacon> accessed 20-Oct-2021

[55] Global Energy Network Institute, 'National Energy Grid, Bangladesh' (2016). [online] Available at: <http://www.geni.org/globalenergy/library/national_energy_grid/bangladesh/index.shtml> [Accessed 18 October 2021].

[56] Ibid

[57] Web.worldbank.org. n.d. *Bangladesh's Bangabhandu Jamuna Multipurpose Bridge*. [online] Available at: <http://web.worldbank.org/archive/website00811/WEB/OTHER/0FE29D29.HTM?OpenDocument> [Accessed 18 October 2021].

complete, at the cost of over $900m. It supports four lanes of traffic, a dual-gauge railway track (broad and metre), power lines, gas pipelines, and fibre-optic telecommunications cables.[58] Additionally, the country is constructing the Padma Multipurpose Bridge, which would be Bangladesh's largest bridge and its first permanent river crossing for road traffic when completed,[59] further strengthening west-east transportation and logistics.

Bangladesh – Natural Gas Powering Success

The development of Bangladesh's upstream natural gas sector has been an important factor in powering this developmental success. The country has 27 different natural gas fields, from which cumulative extraction reached 18.2 trillion cubic feet (tcf) by December 2019.[60] The primary energy mix comprises roughly 64% natural gas, 21% furnace oil, 2% coal, and 2% hydro.[61] That natural gas supply has driven a nearly 300% increase in Bangladesh's electricity capacity in the 12 years from 2007 to 2019: from 3,700 MW to 13,000 MW.[62] Aggregate installed capacity, including captive generation and imported power, subsequently increased substantially again, reaching a new total of *c.*18,753 MW as reported this year.[63]

Even so, Bangladesh faces an energy deficit: whilst 90% of the population has access to electricity supply, these "electricity consumers can only use the electricity in their daily life on a roaster basis due to the lack of continuous power supply."[64] To close this gap, national policy is strongly supportive of further expansion in natural gas production, as confirmed in Bangladesh's draft 2020/21 national energy strategy. This is a sharp departure from two years' previously, when enhanced coal mining and thermal energy production was also recommended, and with gas selected "rather than solar and wind power as an alternative, due to land issues and energy storage costs."[65]

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[58] Ibid

[59] Bangladesh Bridge Authority, *Padma Multipurpose Bridge Project*. [online] (2021), Padmabridge.gov.bd. Available at: <http://www.padmabridge.gov.bd/> [Accessed 18 October 2021].

[60] Minsitry of FInance, *Bangladesh Economic Review 2021: Power and Energy* (Bangladesh 2021)

[61] Das, N. K., Chakrabartty, J., Dey, M., Gupta, A. S., & Matin, M. A., 'Present energy scenario and future energy mix of Bangladesh.' (2020), *Energy Strategy Reviews*, 100576.

[62] Akhtar Mahmood, '*Bangladesh's remarkable development journey: Government had an important role too*.' (2021), [online] Brookings. Available at: <https://www.brookings.edu/blog/future-development/2021/07/09/bangladeshs-remarkable-development-journey-government-had-an-important-role-too/> [Accessed 18 October 2021].

[63] Akhtar Mahmood, '*Bangladesh's remarkable development journey: Government had an important role too*.' (2021), [online] Brookings. Available at: <https://www.brookings.edu/blog/future-development/2021/07/09/bangladeshs-remarkable-development-journey-government-had-an-important-role-too/> [Accessed 18 October 2021].

[64] N. K. Das and others, 'Present energy scenario and future energy mix of Bangladesh' (2020) 32 Energy Strategy Reviews 100576

[65] Syful Islam, 'Bangladesh set to embrace gas, rather than renewables' (*PV Magazine,* 2020) <https://www.pv-magazine.com/2020/09/16/bangladesh-set-to-embrace-gas-rather-than-renewables/> accessed 25-Sep-2021

Bangladesh – Renewable Energy?

The limited extent of a renewable energy transition in Bangladesh is illustrated by the estimates of consultancy firm Wood Mackenzie, which consider that renewables will only make up 6% of total energy generation in Bangladesh by 2020.[66] Whilst Bangladesh's government has set itself a 2041 target of sourcing 40% of electricity from renewables, it is also quoted as effectively caveating that commitment by saying that "the government is hesitant to undertaking a 'crash program' to realize the goal." The direction of travel is clearly in favour, currently, of greater and greater reliance on natural gas rather than renewable energy. Its 40% renewables target pales in comparison with the 100% renewable energy commitment that it and the 47 other members of the Climate Vulnerable Forum (CVF) (a global partnership of countries that are disproportionately affected by the consequences of global warming)[67] committed to by 2050.[68] The partnership is currently (2020 – 2022) chaired by the Government of Bangladesh.

It is not clear to the authors of this Research Insight how these targets for renewable energy generation can be reconciled by the revealed preference of Bangladesh's government for natural gas development in preference to a large-scale renewable energy transition, reaching up to the point of 100% of downstream energy generation in just 29 years from now.

Bangladesh – Threat of Climate Change

For Bangladesh, the need for globally successful action on climate change, even if this pragmatically takes the main form of switching from coal to natural gas rather than at-scale renewable energy, could not be starker. Figure 2 above shows the High level of Physical Risk identified by the EIB for the country. From simple observation of a map, Bangladesh's "low elevation and high population density do make it distinctly vulnerable to rising sea levels and natural hazards like cyclones."[69]

The Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index model of the University of Notre Dame, USA, provides an external data set of climate change "resilience" for different countries. ND-GAIN climate change resilience data points of Commonwealth upstream petroleum countries are shown in Figure 3 below. As for Figure 2 above, the (logarithmic) y-axis shown is that of petroleum rents as a

[66] Wood Mackenzie, 'Bangladesh to double its fossil fuel imports in a decade' (*Wood Mackenzie,* 2020) <https://www.woodmac.com/press-releases/bangladesh-to-double-its-fossil-fuel-imports-in-a-decade/> accessed 25-Sep-2021

[67] Climate Vulnerable Forum, 'About' (*CVF,* 2021) <https://thecvf.org/about/> accessed 25-Sep-2021

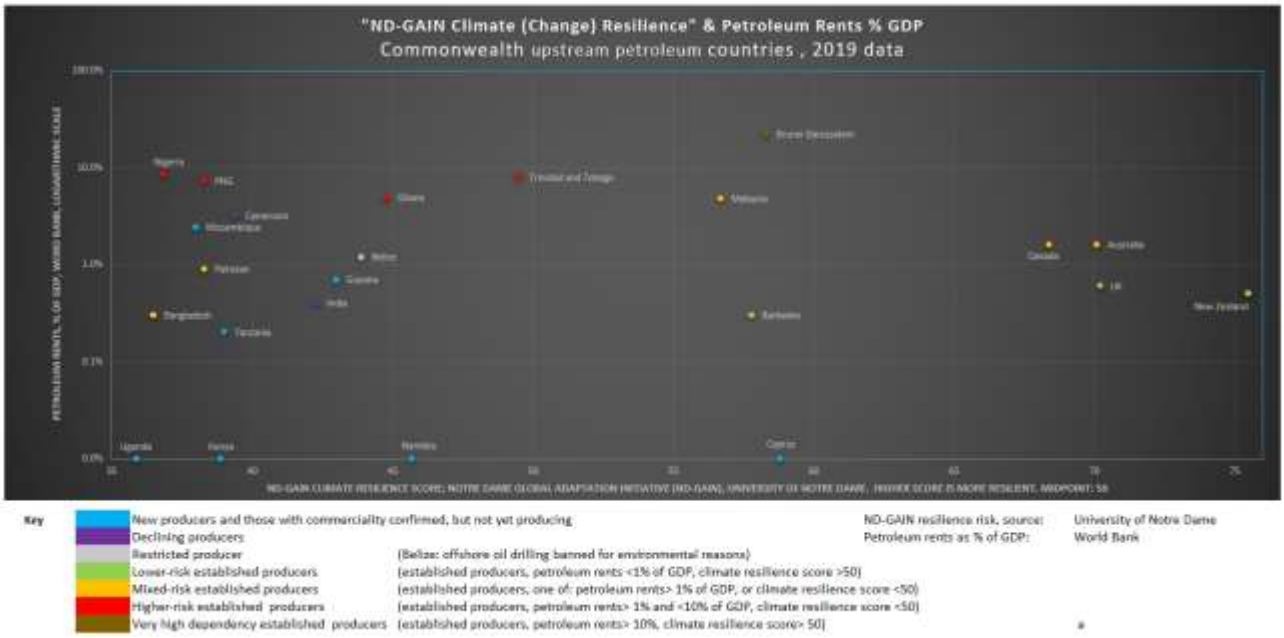
[68] Matt Payton, 'Nearly 50 countries vow to use 100% renewable energy by 2050' (*Independent,* 2016) < https://www.independent.co.uk/climate-change/news/renewable-energy-target-climate-united-nations-climate-change-vulnerable-nations-ethiopia-a7425411.html> accessed 20-Oct-2021

[69] Joyashree Roy, 'Basket Case to Beacon, How Bangladesh Transformed Itself into a Modern and Resilient Society' <https://thebreakthrough.org/journal/no-14-summer-2021/bangladesh-energy-beacon> accessed 20-Oct-2021

percentage of GDP, again illustrating the level of reliance of each country on the petroleum sector.

A range of developing countries like higher risk (Papua New Guinea (PNG), Nigeria, Ghana, and Trinidad and Tobago) Commonwealth countries are identified above, namely those with relatively poor (<50 ND-GAIN score) and at least 1% petroleum of GDP rents achieved, all highlighted in red above. In comparison, Bangladesh has a lower risk, as per its moderate level of petroleum rents achieved/reliance. Still, it has the second-lowest ND-GAIN score of any other country shown.

Figure 3



Five developing countries are also shown in Figure 3 above with similarly (between 35 and 40) low ND-GAIN climate change resilience scores, but higher levels of reliance on the petroleum sector, measured by the sector's percentage rents, account for national GDP. Those countries are Nigeria and PNG; both rated as High risk, Pakistan (a case study for which is presented below), new petroleum producer Mozambique, and declining producer Cameroon (also a case study in this paper). Other notable countries in Figure 3 include Belize, which has the distinction amongst Commonwealth producers for having banned offshore upstream exploration out of concern for the environmental protection of its coral reef ecosystems. Further, Brunei Darussalam, the sole 'very high dependency' petroleum producer, achieved over 10% (in fact: 22%) of GDP economic rent from upstream petroleum.[70]

Whilst Bangladesh does not have the same level of economic threat implied by such a high level of dependency on upstream petroleum (for instance, a truly global energy transition might be expected to result in hugely reduced levels of demand for

[70] The most recent date for which comparative figures are available.

petroleum products and, all other things being equal, prices) as Brunei Darussalam, or even PNG or Nigeria, Bangladesh's very low level of ND-Gain score – above only Uganda amongst these Commonwealth countries – is a huge cause of concern.

This low ND-GAIN score reflects the fact that Bangladesh is particularly threatened by climate change, especially the specific climatic change threat of rising sea levels. Its threat level is due to, *inter alia,* the country's very low elevation topography, and high population density, and poor infrastructure. At the extreme end of sea-level exposure, three-quarters of the Ganges delta Sundarbans region of the country, home to over 4.5m people and rich in fauna and flora, would be inundated by just a 45 cm sea-level rise and could be completely inundated in the case of a 67 cm rise.[71] Should the sea level rise be greater, a more extensive part of the country would be submerged, leading to even more millions of Bangladeshis being displaced. Secondly, and in terms of heatwaves, when these occur – defined as temperatures remaining above the 95th percentile for three consecutive days and nights – overall mortality rates are observed to increase by about 20%.[72] The north and northeast of Bangladesh are particularly susceptible to high flood risks and higher levels of extreme poverty, which are most pronounced along the southern coasts.[73]

Bangladesh – NDC

As a result of this extreme climate threat, Bangladesh's NDC outlines a two-fold strategy of pursuing both enhanced climate change resilience alongside GHG reduction. In the NDC (see Annex 2) , the country unconditionally commits to a GHG emissions reduction of 6.73% below the Business as Usual (BAU) scenario, as at 2030, in a range of industrial sector, and an enhanced 15.12% conditional cut, notably reliant on sufficient financial support: $100bn USD of finance climate p.a. was promised by developing countries to help the developing world, a pledge that remains largely undelivered.[74]

In Bangladesh, renewable energy does not currently have primacy in public policy. Instead, that place is occupied by natural gas, a lower GHG emitter than the practical alternatives of oil and coal. For Bangladesh, the substitution of oil and coal in favour of gas is central in meeting the above NDC targets.

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[71] Shardul Agrawala, *Development and climate change in Bangladesh: Focus on coastal flooding and the sundarbans* (OECD 2003)

[72] Hannah Nissan and others, 'Defining and predicting heat waves in Bangladesh' (2017) 56 Journal of Applied Meteorology and Climatology 2653

[73] Development Initiative, 'Supporting longer term development in crises at the nexus: Lessons from Bangladesh' (2021). Report. https://devinit.org/documents/948/Supporting_longer_term_development_in_crises_at_the_nexus_Lessons_from_Bangladesh.pdf

[74] UN Climate Change, 'UN Climate Chief Urges Countries to Deliver on USD 100 Billion Pledge' (*UNFCCC,* 2021) <https://unfccc.int/news/un-climate-chief-urges-countries-to-deliver-on-usd-100-billion-pledge> accessed 25-Sep-2021

Bangladesh – Uncertain Energy Future

However, whilst demand for natural gas is high, particularly domestically extracted natural gas that does not carry the price premium of imported Liquified Natural Gas (LNG), there is a question mark regarding available reserves and their worryingly rapid depletion. Writing in 2019, Shetol, M., *and others.,* report that the country had (then) about enough gas for approximately 10 to 12 years of supply.

Hence there is a need to identify new resources, an uncertain and lengthy endeavour, and/or discover new exploitable reserves in existing gas fields, that is, to achieve "reserve growth", e.g. through both "new techniques such as detailed digital reservoir characterization technique which might increase the total gas reserve,"[75] and enhanced techniques of resource recovery through the implementation of new technologies.

Success in this endeavour is uncertain: expenditure on petroleum exploration, reservoir re-characterisation, and enhanced recovery may or may not lead to more commercial petroleum discovery. Moreover, even if it does for some time, it is unrealistic to expect that it would continue to do so repeatedly, continually providing commercial replacement reserves to those depleted over time.

Pursuing hard-to-extract natural gas through enhanced recovery techniques may, under certain conditions, bring into question the low-GHG, 'transition', status of that fuel since the greatest gains in carbon reduction are made by improving gas management and halting the production of the 'dirtiest reservoirs', meaning those that are the most energy-intensive to develop and produce.

More positively, the government of Bangladesh has demonstrated a willingness to prioritise renewables, as proven by its initial selection of renewables as its strategic downstream source of energy of choice, and through renewable energy initiatives such as the new Green Transmission Fund, "a USD $200m refinancing scheme for environmentally-friendly initiatives launched in 2016—expanded its scope in June 2019 from just three sectors (textiles, leather, jute) to include all manufacturing and export-oriented entities, irrespective of sector."[76]

Bangladesh – Civil Nuclear Programme

Bangladesh's other pathway is the pursuit of civil nuclear energy due to its low carbon emissions footprint to further its clean energy ambitions and reduce its reliance on natural gas. According to the World Nuclear Association, Bangladesh began

[75] M. Hassan Shetol and others, 'Present status of Bangladesh gas fields and future development: A review' (2019) 4 Journal of Natural Gas Geoscience 347

[76] Green Finance Platform, 'Bangladesh's Green Transformation Fund (GTF)' (*GFT,* 2019) <https://www.greenfinanceplatform.org/policies-and-regulations/bangladeshs-green-transformation-fund-gtf> accessed 25-Sep-2021

construction of its first nuclear power reactor, ROOPPUR 1, in November 2017, and this is scheduled to be operational by 2023. Construction works at the second unit at Rooppur began in July 2018. The country has had its first reactor pressure vessel installed by Russia's state-run nuclear power corporation (Rosatom) at the Rooppur atomic power plant. Bangladesh is looking at the long-term benefits of nuclear power. For instance, the Rooppur nuclear power station is situated on the Ganges riverbank, 160 kilometres from the capital Dhaka. It will feature two VVER-1200 reactors with a 60-year design life that can be extended by additional 20 years.[77]

Speaking at the inauguration of the first reactor installation on 10 October 2021, Prime Minister Sheikh Hasina said about the benefits of nuclear energy to the country, noting that "it is therefore environmentally friendly and helps combat the adverse effects of climate change. In line with our plans for the development of the country, our power plant will help us achieve the Sustainable Development Goals by 2030 and contribute to a gradual transition to become an industrialised country by 2041."[78]

Bangladesh – Summary

As we have considered above for the UK, we may ask whether Bangladesh's public policy amounts to a climate-compatible pathway that supports economic growth?

The answer is uncertain and nuanced: Bangladesh is constrained by its current downstream energy (electricity) deficit and the need to meet that gap urgently for the benefit of its citizens. Pragmatically, it has selected natural gas as its fuel of choice and has achieved very considerable and notable developmental success as a result. But the country is also constrained in its long-term development, not least by geology/ exploration success achieved to date. Additionally, it is also pursuing renewable energy, but the evidence is lacking that it is doing so as its targeted commitments, including a 100% switch to renewable energy by 2050, implicitly demand. More positively in climate terms, its transition away from coal has been comprehensive and dramatic.

While making all of these public policy choices, the country's government and policy-makers appear to be acutely aware of the imminent and potentially devastating threat faced by maritime inundation of its vast, low-lying, heavily populated, coastal regions.

Bangladesh needs and deserves all the international help it can get to mitigate the impacts, enhance its resilience, and reduce its contribution to the causes of climate change. One clear conclusion of this analysis is that there is no obvious end to petroleum evident from the analysis of Bangladesh as a Commonwealth case study,

[77] Hindustan Times, '*First nuclear reactor pressure vessel installed at Bangladesh atomic power plant'*. [online] (2021) Available at: <https://www.hindustantimes.com/world-news/first-nuclear-reactor-pressure-vessel-installed-at-bangladesh-atomic-power-plant-101634030654305.html> [Accessed 18 October 2021].
[78] Ibid.

given its practical reliance on, and revealed preference for, natural gas in replacement of coal-fired power.

A second such conclusion is that the country has identified a further way to decarbonise its energy mix, namely the development of a civil nuclear energy programme. In doing so, and with respect to future intention rather than present reality, this places the country alongside this Research Insights' case study countries UK and Pakistan, both of which already generate downstream energy from nuclear power.

However, if Bangladesh were to achieve a 100% switch to renewable energy supply, as it is committed to doing by 2050 as a CVF signatory country (see above), then that would imply that any petroleum it extracted would purely be for export, not domestic consumption. Whilst in the context of natural gas that is possible, e.g. natural gas exports transported via maritime LNG or pipelines, the history of Bangladeshi natural gas upstream development is for it to secure affordable and at-scale domestic supply. Moreover, a policy implemented, at considerable likely economic cost, for ethical, environmental reasons to switch to 100% renewable energy would surely be incongruous with the continued export of oil or natural gas. Hence, the achievement of such a 100% renewables transition may go hand-in-hand with the ending of Bangladesh's upstream petroleum production, particularly if resource depletion was acting as a driver in that direction already. Clearly, Bangladesh is not there yet in terms of demonstrating the realism of such a 100% switch to renewable energy, even by 2050, and therefore any declaration of an 'end' to Bangladeshi oil and/or gas in the foreseeable future, at least as a result of intended public policy, is premature. More likely is the practical fact of extraction no longer being economically viable due to resource depletion; however, even that scenario is dependent upon unknowable factors such as future petroleum prices and advances in applicable technologies.

Case Study 3 – Pakistan

Pakistan – Introduction

Pakistan's Government has notably few Climate Targets in place, as measured by the Grantham Institute (GRI) of Climate Change and the Environment[79], and a very low ND-GAIN Climate Resilience score. Figure 4 below shows just those Commonwealth countries with ND-GAIN Climate Resilience scores below 50, the midpoint, i.e. those with lower resilience; and, just those with fewer than 15 (the approximate GRI data midpoint) Climate Targets in place. It is striking that Pakistan has one of the lowest ND-GAIN scores of any Commonwealth country by displaying this quadrant. It has one of the lowest numbers of Climate Targets in place; in fact, just two Commonwealth countries score lower on both metrics, namely Mozambique and Sierra Leone, and both only marginally re. ND-GAIN.

Figure 4

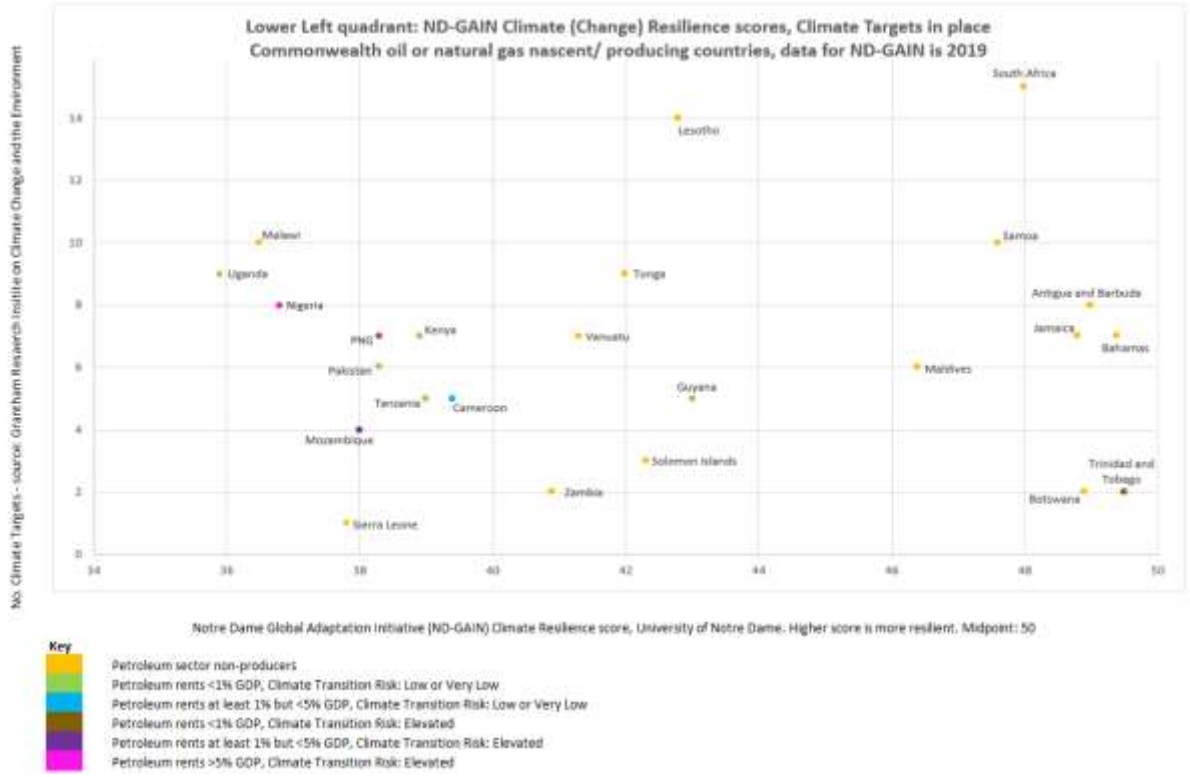

Figure 4 above also shows, as per its Key, that the EIB rates Pakistan as Low with respect to Transition Risk and that its petroleum rents are less than 1% of GDP. In sum, Pakistan is rated at low economic risk from a transition to low/no-GHG energy, and away from fossil fuels, has a low level of economic rent reliance on its upstream petroleum sector, whilst being highly exposed to the risks of climate change (since it has low resilience to that change), yet few Climate Targets in place. As such, it

[79] Grantham Research Institute of Climate Change and Environment, 'Pakistan - Cllimate Targets' (*Climate Laws - LSE,* 2021) <https://climate-laws.org/geographies/pakistan/climate_targets> accessed 25-Sep-2021

represents an important case study for a Commonwealth upstream petroleum country that is not displaying as proactive a climate policy stance as might reasonably be expected for it given its energy sector and climate change-threatened predicament. While both its climate change Transition Risk and economic rents reliance on petroleum are low, Pakistan's day-to-day reliance on petroleum for fuel– both domestically produced and imported (especially in the form of LNG) – is high. In 2020, Pakistan's Oil and Gas Regulatory Authority (OGRA) noted that: natural gas and residual fuel oil supplied 36% and 25% of Pakistan's commercial energy consumption, respectively; and that 29% of this natural gas consumption had been supplied from LNG imports.[80]

Pakistan – Upstream Producer

In terms of its own production, Pakistan's upstream sector reached commerciality in 1955, when it started extracting gas from Sui, in its southwestern province of Baluchistan.[81] Further commercial discoveries followed; however, overall gas reserves have fallen since their scale has been insufficient to match depletion rates. Indeed, ever-increasing domestic electricity demand and the depletion of gas reserves have resulted in the country being in an energy deficit. At the end of 2020, BP estimated Pakistan's total gas reserves of Pakistan at 13.6 Trillion Cubic Feet (TCF),[82] and having a reserves-to-production ratio implies exhaustion, all other things being equal, in just 12.6 years.[83]

Suppose Pakistan is to move away from petroleum domestically. In that case, it will need to switch to an affordable and achievable alternative to rely upon instead and then achieve the necessary momentum to make that change.

Pakistan - Current Energy Mix

Traditionally, hydropower has been important for Pakistan in terms of downstream energy generation. However, the declining precipitation levels, upfront construction costs for building new hydropower projects, and increased electricity demand have increasingly prompted a drive to direct investment in new power generation elsewhere. Even so, hydropower remains a materially important contributor to Pakistan's energy mix to date, notably contributing 30.77% to the generation basket of the central power procurement agency (CPPA) of Pakistan in the financial year 2019-2020.[84]

Whilst hydropower is essential, it is not expected to grow relative to Pakistan's increasing demand for electricity. The latter is fed by both growing demographics and a rising high-energy consuming middle class. Neither is it expected to grow, perhaps

[80]Oil & Gas Regulatory Authority, *State of the Regulated Industry Report 2019-2020* (OGRA Pakistan 2020), 34
[81] H. R. Tainsh, K. V. Stringer and J. Azad, 'Major Gas Fields of West Pakistan1' (1959) 43 AAPG Bulletin 2675
[82]British Petroluem, *Statistical Review of World Energy* (BP 2021), 34
[83] Ibid, 34
[84]National Electric Power Regulatory Authority Pakistan, *State of Industry Report 2020* (NEPRA 2020), 7

even in absolute terms as climate change erodes the level of precipitation that Pakistan can reliably expect year-on-year.

In recognition of the constraints faced in the development of any significant new hydropower generation and in order to address the situation of recurrent power shortages,[85] Pakistan's government stimulated the creation of new, thermal Independent Power Producer (IPPs), developing any significant new hydropower generation and addressing the situation of recurrent power shortages, Pakistan's government stimulated the creation of new thermal Independent Power Producer (IPPs) through Electricity Market Reforms that it initiated in 1994. In addition to the catalysation of these new IPPs, the government re-categorised (in fiscal/accountancy terms) the utilisation of petroleum as a pass-through cost item, spurring higher levels of its fuel consumption within Pakistan, amongst other far-reaching consequences.[86]

Overall, these policy incentives led initially to the use of more residual fuel oil (in particular) for thermal power generation, and that fuel's recent dominance (54.80% in 2013-2014)[87] for Pakistani electricity generation before its later reduction (31.58% in 2018-2019).[88] The relative importance of the IPPs is shown by the fact that in 2020 it was reported[89] that thermal IPPs provided nearly half (49.71%) of electricity to CPPA's generation basket.

The upshot of the above changes, grounded in part due to concerns about the viability of the prospect of any material increases in hydropower generation (and perhaps even its reliability of future supply), was therefore increasing reliance on the domestic use of three types of fossil fuels, namely coal, natural gas extracted within the country, and imported LNG for electricity generation. More positively from a climate perspective is the reduction, noted above for residual fuel oil from 2013-2014, when it accounted for over half of thermal power generation, to 2018-2019. By that time, it had accounted for under a third of such generation.

This situation stagnated energy capacity expansion and raised concerns about 'circular debt' which was acknowledged in national accounting ledgers in 2008.[90] Trimble and others. have explained the term 'circular debt' as a "debt created in the power sector when end-customers (both public and private) do not fully pay their electricity bills to distribution companies, and the GOP is not able to fully furnish its commitment to fund subsidies paid to distribution companies. As a result, the

[85] The report cited in Note above (current note 61) lists thermal IPPs as the ones generating electricity from natural gas, residual fuel oil, LNG, and coal, 28

[86] Robert Bacon, 'Learning from Power Sector Reform: The Case of Pakistan' (*World Bank Group,* 2019) <https://openknowledge.worldbank.org/handle/10986/31667> accessed 25-Sep-2021, 13

[87] National Electric Power Regulatory Authority Pakistan, *State of Industry Report 2015* (NEPRA 2015), 80

[88] National Electric Power Regulatory Authority Pakistan, *State of Industry Report 2020*, 81

[89] Ibid, 81

[90] Amna Tauhidi and Usman W Chohan, 'The Conundrum of Circular Debt' (2020)

distribution companies are unable to pay their power purchase cost to the CPPA/ single buyer, which is in turn unable to fulfil its obligation to power generation companies. In turn, the power generation companies (public sector generating companies [GENCOs], Karachi Electricity Supply Company [KESC], and independent power producers [IPPs]) fail to pay fuel suppliers. Further, the fuel suppliers default on their payment to refineries, gas producers, and international fuel suppliers." [91] Trimble also commented that since the two gas utilities, Pakistan State Oil, and major oil and gas producers were also in government ownership, the term 'circular debt' (not a very accurate one) has become the term commonly used for this debt.

However, the volatile nature of petroleum prices, combined with Pakistan's increasing reliance on such petroleum imports, levels of debt within the downstream energy sector, and its alleged poor governance, all combined to result in a Pakistani energy crisis. Aftab noted that this energy crisis became ominously evident in 2007 by oil prices inflation, adding a 36% increase to Pakistan's import bill.[92]

Besides exposing the Government to risks of default on sovereign guarantees, the circular debt also pushed it to re-consider the constituents, and their relative levels of power contribution, to the country's energy mix. In its Power Tariff and Subsidy Guidelines 2014, Pakistan's government acknowledged and defined the circular debt; and mandated its elimination in Pakistan as a material issue by switching to 'cheaper fuel sources'.[93]

Pakistan - Coal and COP26

Instead of more renewables, this cost-reduction dynamic led to more imported coal, a particularly high GHG-emitting primary energy source. Strikingly, in 2015, Pakistan entered an arrangement with the Government of the People's Republic of China (PRC), the China Pakistan Economic Corridor (CPEC), under its Belt and Road initiative. CPEC projected energy sector investments from the PRC of USD $33.70bn, with a significant emphasis on imported coal as an energy source.[94]

In parallel with these domestic concerns and *de facto* pro-fossil fuel energy policy developments, Pakistan ratified the Paris Agreement at COP-21, and, pursuant to that international agreement, submitted its climate change NDC. Pakistan's NDC, published in 2016 (see Annex 2 below), linked back to domestic energy supply

[91] Chris Trimble, Nobuo Yoshida and Mohammad Saqib, *Rethinking Electricity Tariffs and Subsidies in Pakistan* (The World Bank 2011), 3

[92] Safiya Aftab, 'Pakistan's energy crisis: causes, consequences and possible remedies' (2014) Expert Analysis, Norway

[93] Economic Coordination Committee, *National Power Tariff and Subsidy Guidelines* (Ministry of Water and Power, Pakistan 2014), Guideline E

[94] Faisal Mehmood Mirza, Nishat Fatima and Kafait Ullah, 'Impact of China-Pakistan economic corridor on Pakistan's future energy consumption and energy saving potential: Evidence from sectoral time series analysis' (2019) 25 Energy Strategy Reviews 34

concerns by explicitly citing a 'prevailing energy crisis' case in Pakistan. It forecasted an increase in energy sector GHG emissions from 185.97 Million tonnes (Mt) CO_2 in 2015 to 898 Mt CO_2.[95]

Though, Pakistan, in its updated NDC 2021 (conditioned on grant/aid), has made ambitious claims such as 60% of total energy production to be made from renewables and a moratorium on imported coal.[96] Hydro power has been included as a renewable source contrary to the Governments earlier position under this updated NDC.

Hence, its NDCs can be interpreted in part as a response to domestic concerns rather than global climate change. Regarding the latter, the NDC's commitments are substantially conditional upon foreign grants being provided to help fund Pakistan's lower-GHG energy transition, e.g. its commitment made in the NDC to reduce "up to" (so, perhaps less or even far less of a reduction in practice) 20% of its 2030 projected GHG emissions is caveated in exactly that manner.

Approaching COP-26 in late 2021, Pakistan's energy mix continued to evolve towards more fossil fuel reliance and less low-GHG emitting energy sources.

Two years prior to the re-scheduled COP-26, Pakistan's Alternative Renewable Energy Policy 2019 (ARE 2019) was officially approved by the Government, a policy that emphasises the vital importance of cost-effective electricity procurement, pursuant to the imperative for affordability-driven switching noted above.

That switch was not positive in terms of Pakistan's government-sanctioned renewable energy aspirations: ARE 2019 replaced the earlier 2006 policy that encouraged the achievement of 1235 MW and 430 MW of wind and solar capacity, respectively.[97] ARE 2019 prescribed renewable energy procurement based on Indicative Generation Capacity Expansion Plan (IGCEP) outputs as per IGCEP 2021, as published by Pakistan's (state-owned) National Transmission Dispatch Company (NTDC).

Controversially, ICGEP 2021 suggested a reduced level of utilisation of solar and wind for planning horizon to 2030 scenario, a date also commonly used in climate change action planning, including NDCs. In response, the Institute for Energy Economics and Financial Analysis (IEEFA) criticised the IGCEP 2021 for suggesting this reduction, which substituted a target of just 12% of electricity generating capacity for wind and solar combined, as compared to the previous target of 30% by 2030 set by ARE 2019, a very substantial drop.[98]

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[95]Government of Pakistan, *Pakistan's Intended Nationally Determined Contribution (PAK-INDC) 2015* , 26

[96] Government of Pakistan, *Pakistan Updated Nationally Determined Contribution 2021*, 62

[97] Alternate Energy Development Board, 'Current Status of Wind Power Projects' (*Pakistan,* 2021) <http://www.aedb.org/ae-technologies/wind-power/wind-current-status> accessed 25-Sep-2021

[98] Institute for Energy Economics and Financial Analysis, 'IEEFA: Pakistan's new long-term power plan – one step forward, two steps back' (*IEEFA,* 2021) <https://ieefa.org/ieefa-pakistans-new-long-term-power-plan-one-step-forward-two-steps-back/> accessed 25-Sep-2021

Alongside and complementary to the need to improve Pakistan's energy generation's cost-effectiveness, it is imperative to ameliorate its governance. Pursuant to that objective, in 2020, Pakistan's National Electricity and Power Regulatory Authority (NEPRA) approved further positive actions towards liberalisation by accepting the Competitive Bilateral Trading Contractual Market (CBTCM) Model to improve energy procurement.[99] The emphasis is on enhanced governance levels, where the expansion of the energy sector is guided by IGCEP rather than occurring free-standing of public policy and cost-efficient procurement, reflecting the longstanding imperative of pubic affordability.

Hence, IGCEP is applicable as a guiding document to enable capacity procurement and expansion by project executing agencies;[100] and ARE 2019 mandates state procurement through transparent and competitive bidding, also as part of a combined drive for enhanced sectoral levels of good governance.

Regardless of efforts to improve sectoral governance, the overall climate impact of the past decade of government energy policy is that of fossil fuel primacy. Figures for the financial year 2019-2020, specific to the roughly half proportion of energy (see above) provided by thermal IPPs within CPPA's generation basket, [101] show the relevant breakdown as per Table 1 below.

Table 1

Fuel	**Contribution %**
Natural Gas	25.28%
LNG	32.88%
Residual Fuel Oil	10.00%
Coal	31.84%

Moreover, the State of Industry Report 2020 confirmed an increased share of coal in Pakistan's downstream electricity energy mix, from 31.84% compared to its contribution of 13.29% in the financial year 2018.[102]

[99] National Electric Power Regulatory Authority, 'Determination of the Authority in the matter of Detailed Design and Implementation Roadmap of the Competitive Trading Bilateral Contract Market (CTBCM) ' (*NEPRA Pakistan,* 2020) <https://www.nepra.org.pk/licensing/Licences/CTBCM/2020/LAM-01%20Determination%20CTBCM%2012-11-2020.PDF> accessed 25-Sep-2021

[100] National Transmission and Dispatch Company Pakistan, 'Indicative Generation Capacity Expansion Plan ' (*NEPRA,* 2021) <https://nepra.org.pk/Admission%20Notices/2021/06%20June/IGCEP%202021.pdf> accessed 25-Sep-2021

[101] Ibid, 28

[102] National Electric Power Regulatory Authority Pakistan, *State of Industry Report 2020*, 29

Pakistan – Prognosis

Whilst very negative in climate change policy terms, these highly pragmatic policy changes have, reportedly, led to the country achieving a surplus of electricity generation, when previously it had been in electricity deficit.[103] More coal and more natural gas have been key to this turnaround, including expansion further to Chinese investment.[104]

This, in turn, suggests an ongoing reliance on fossil fuels, including very substantial proportions for high-GHG emitting coal and residual fuel oil, and ironically, given the government policy focus on financial cost-effectiveness and affordability noted above, comparatively expensive LNG.

What are the low/non-GHG alternative forms of energy that it could pursue? One such possibility is nuclear power.

Pakistan has had a longstanding civil nuclear capacity since its inception in 1971. The country has been operating nuclear power stations at both Chashma and Karachi. The four Chashma Nuclear Power Plants (CHASNUPP I – IV) supply energy to the CPPA energy basket, and the Karachi Nuclear Power Plants (KANUPP) generate energy for Karachi Electric Company[105] (K-Electric). These nuclear plants are maintained and operated by the Pakistan Atomic Energy Commission, and they have a combined installed capacity of 1467 MW.[106] Pakistan's Economic Survey 2020-2021 reported that KANUPP – II was connected to the grid in March 2021 and had an installed capacity of 1100 MW.[107]

Looking forward, the National Electricity Policy 2021 (NEP 2021) has now been approved by Pakistan's government. It is indicative of the national government's policy for using hydropower, indigenous and imported coal and nuclear energy to meet the obligation of security of supply.

The Economic Survey 2020-2021 asserted that the Pakistani Atomic Energy Commission (PAEC) intended to expand the nuclear capacity to add 8800 MW of nuclear power in line with the Energy Security Plan (2005).[108] NEP 2021 also mentions the run of river projects for expanding the hydropower projects. However, despite the

[103] Faseeh Mangi, 'Nation Plagued by Power Shortages Suddenly Has Too Much Electricity' (*Bloomberg,* 2021) <https://www.bloomberg.com/news/articles/2021-01-27/pakistan-struggles-to-tackle-an-unfamiliar-glut-of-electricity?sref=8HTMF4ka> accessed 25-Sep-2021

[104] Ibid.

[105] K-Electric was unbundled from Water and Power Development Authority (WAPDA) and privatised in 2005. It has its own generation, transmission, and distribution. However, the shortfall in the energy demand is purchased from CPPA.

[106] National Electric Power Regulatory Authority Pakistan, *State of Industry Report 2020,* 7

[107] Governemnt of Pakistan (Finance Division), 'Pakistan Economic Survey (Energy) 2020-2021' (*Finance Division,* 2021) <https://www.finance.gov.pk/survey/chapters_21/14-Energy.pdf> accessed 25-Sep-2021

[108] Ibid

expected addition of 1,100 MW by 2022 through KANUPP – III, procuring nuclear and hydropower through conventional technologies seems challenging given Pakistan's economic situation, for instance, a national budget deficit estimated at *c.*7.5% of GDP in the Financial Year 2020-2021.[109] A contraction in Pakistani GDP of 1.5% has been attributed to the Covid-19 pandemic.[110] The deteriorating economic condition presents a dismal picture for future investment in new projects and appears as a major challenge and risk to public projects.

Pakistan is importing residual fuel oil, LNG, and coal to meet its energy security demands. However, the dangers of 'circular debt' still exist, despite efforts to reform and improve the governance of the downstream energy sector in Pakistan. Indeed, it was reported in July 2021 that the circular debt had soared up to PKR 2.327 trillion (USD $1.483 trillion approximately).[111] In a mixed message regarding fossil fuels, IGCEP 2021 attempts to address the challenges of reducing energy's heavy dependence on fossil fuel imports and energy costs. Still, it does so in part through planning for an increase in the level of indigenous coal in Pakistan's energy mix by 2030, alongside the expansion of both hydropower and nuclear energy – the latter two in common with the objectives of IGCEP 2021 above, the authors here noting the same cautionary caveat regarding the practical obstacles faced by Pakistan in achieving those low/no-GHG objectives of much more hydropower and nuclear energy in the country's downstream energy mix.

Pakistan – Summary

Pakistan's energy policy is faced with the paradox of energy security, costs, and climatic consideration. Figure 2 above shows the High Level of Physical Risk identified by the EIB for the country concerning climate change impacts. Yet, the country's policymakers in government do not seem to be prioritising climate action that takes into full account that peril. Instead, the evidence suggests that Pakistani energy policy is driven more by costs and energy security and a concern to improve sectoral governance than by climate considerations. For example, coal surfaces as a convenient but climate-unfriendly policy choice given the economic situation, circular debt, fast depleting gas reserves, and expansive fuel imports. Finally, with regards to its upstream petroleum production, since this is insufficient even to meet Pakistan's own energy needs, it is ironic that the country still relies on it to provide at least part of its growing hunger for natural gas and residual fuel oil. In this context, there seems little prospect of Pakistan voluntarily ending or reducing its upstream production levels.

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[109] Mhetab Haider, 'FY 2020-21: Budget deficit to be around 7-7.5pc of GDP' (*The News International* 2021) <https://www.thenews.com.pk/print/869376-fy-2020-21-budget-deficit-to-be-around-7-7-5pc-of-gdp> accessed 25-Sep-2021

[110] World Bank, 'Pakistan Overview - Economic update and outlook' (*WB,* 2021) <https://www.worldbank.org/en/country/pakistan/overview#1> accessed 25-Sep-2021

[111] Dawn Newspaper, 'Circular debt soars to Rs2.327 trillion in 2020-21' (*DAWN Pakistan,* 2021) <https://www.dawn.com/news/1632699/circular-debt-soars-to-rs2327-trillion-in-2020-21> accessed 25-Sep-2021

If such a reduction happens anyway, it will instead more likely be a result of petroleum reserves depletion, exhaustion and inadequate new replacement commercial discoveries, rather than due to the freely exercised volition of the Government of Pakistan. This is a surprising conclusion to reach, despite the country's extreme climate threat and low climate change ND-GAIN resilience, as noted in Figure 4 above.

Case Study 4 – Cameroon

Cameroon – Climate Change Action

Cameroon's NDC commitments (see Annex 2 below) include both that:

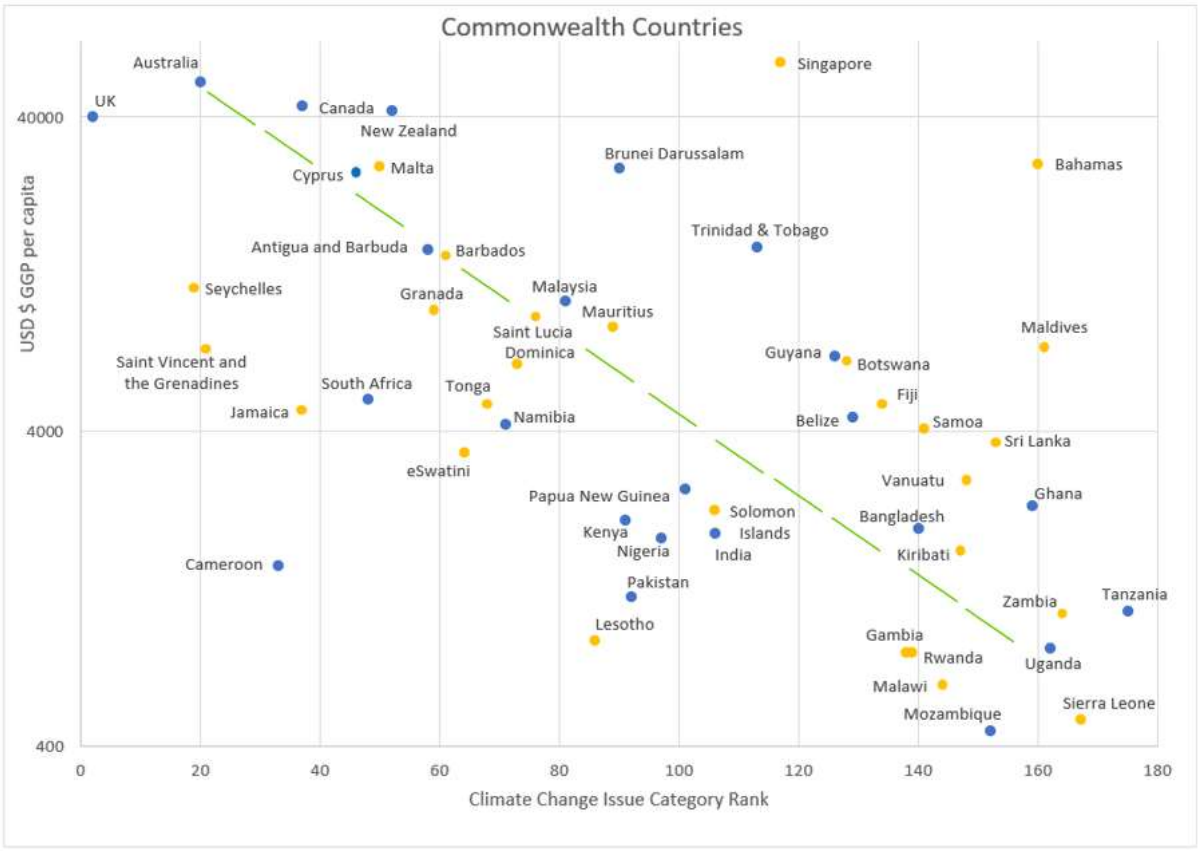
- the country achieves a 32% reduction in GHG emissions compared to a scenario of benchmark for the target year (2035), conditional on community support; and
- renewable energy is to provide a quarter of the country's energy mix by 2035.

Cameroon's action on climate change, and other specific facets of the country's energy sector (see below), are reflected in the country's notably impressive Yale University's Environmental Performance Index (EPI) Climate Change Issue Category Rank.[112] Figure 5 below shows this relationship, utilising a logarithmic scale for GDP, with data points for each of the Commonwealth's 23 upstream petroleum countries shown in blue.

As can be seen, there is a clear inverse relationship between GDP *per capita* and EPI ordinal ranking, where a lower rank indicates higher performance, in this particular case with respect to action on climate change. Cameroon's EPI Climate Change Issue Category Rank is visibly much lower (better) than expected given its GDP level.

[112] For the latest available, 2020, update of the EPI, climate and energy categories of the EPI account for 30% of the EPI's ecosystem vitality score, which, in turn, accounts for 60% of the overall EPI score for each country. Rankings are then derived from those scores. For the previous, 2018, version of the EPI climate and energy only accounted for 25% of the EPI's ecosystem vitality score.

Figure 5



Of the above countries in Figure 5, Cameroon is the biggest outlier in terms of a higher ordinal rank/better Climate Change category rank than would be expected given its GDP *per capita* and derived from the approximated trend line above. Cameroon is an interesting example of energy transition complexity and one that highlights the issue of risk in terms of both policymaking and in determining many different outcomes, including both petroleum output and investment decisions.

Cameroon – Paradox

However, there is a paradox at the heart of these figures. At the same time: (1) the Yale University Climate Change issue category rank of 33 for Cameroon is the highest of any continental African country; (2) yet the state is seeking to develop its upstream petroleum sector further and increase production; and (3) the fact of declining oil (but not gas, see below) production is not as a result of purposeful climate policy, but rather as a result of physical insecurity leading to *force majeure* closures of operations in both the Bakassi peninsular (for decades both a territorial claim of, and occupied by, Nigeria) of the country's southwest, and in Zina-Makary in its far north.[113]

[113] Ed Reed, 'Insecurity in Cameroon derails exploration' (*Energy Voice,* 2020) <https://www.energyvoice.com/oilandgas/africa/240734/insecurity-in-cameroon-derails-exploration/> accessed 25-Sep-2021

Cameroon - Cameroun Vision 2035

As per the government's strategic document (which uses the Francophone name of the country) Cameroun Vision 2035, regarding extractive industries sectoral development, "priority will be given first to hydrocarbon sectors (oil and gas),"[114] and that "the objective is to double energy production, thus increasing the GDP unit from the current 27.7 % to 45 % by the end of the vision period. The major medium-term targets are: 33.5 % in 2015; 40 % in 2025 and 45 % in 2035. Hydroelectricity and gas will be used in particular as main sources of power production."[115] Herein the imperative given to natural gas upstream development (alongside more hydropower) is clear. This development objective exists alongside, and contained within the same document, additional renewable energy strategies of achieving, also by 2025,"improved clean power supply to boost economic growth and stem the tide of climate change, notably by diversifying energy sources (wind, nuclear, bio-fuel, solar…), and replacing fossil fuels by clean energy supplies" and "enhancing the protection potential from the harmful effects of climate change."[116] Likewise, and noting the "modest in absolute terms", the Cameroun Vision 35 strategy mandates "intensifying oil exploration thanks to the new oil code which is now available, and by constantly exploiting marginal fields."[117] In summary and as per this strategic document, Cameroon is committed to achieving higher levels of downstream energy supply to meet its growing domestic needs and has identified both upstream petroleum development and an expansion of renewable energy generation as key to achieving that strategic objective, the latter explicitly linked to environmental and climate change objectives.

Cameroon – Summary

This Cameroonian case study illustrates that a country's climate performance, and upstream petroleum sectoral output, may be as much a result of unintended events as purposeful public policy. The fact that the Cameroun Vision 2035 identifies weaknesses implied by the objective of "curbing the downward trends and above all preventing the discontinuation of crude oil production" indicates the weakness of upstream oil development in the country. The fact of *force majeure* upstream petroleum declarations and attendant production cessations in 2020 illustrates continuing obstacles in the country avoiding such "downward trends" in petroleum production.

Whether or not it achieves more success in its renewable energy sector development, which is more flexible in terms of its geographical location and therefore could be directed to physically more secure parts of the country, will be critical in determining

[114] Ministry of Economy Planning and Regional Development, *Cameroun Vision 2035* (Government of Cameroon 2009), 37
[115] Ibid, 26
[116] Ibid, 36
[117] Ibid, 40

any pathway to it achieving a more sustainable, lower-GHG emitting energy future. If it does so, then that is likely to be the result of a mix of purposeful public policy on energy transition (i.e. “diversifying energy sources, wind, nuclear, bio-fuel, solar” as above), and the ongoing frustration of an upstream petroleum sector were merely “preventing the discontinuation of crude oil production” is measured as a success.

If Cameroon were to point to an ‘end to oil and gas’, then that end would be by accident, not design. Does this Cameroonian case study suggest a climate-compatible pathway that also supports economic growth? Based on the evidence presented above, the answer does not seem to be positive. Having a “vision” for 2035 is not the same as being able to demonstrate that it is likely to be realised as designed, and Cameroon’s economic and energy pathway seems more emphatically shaped by happenstance than volition.

Case Study 5 - Trinidad and Tobago

Trinidad and Tobago – No End to Petroleum

Analysis of their upstream sector reinforces the conclusion, already suggested by case studies above, that there is no immediate end to the world's upstream petroleum in sight.

Instead, Trinidad and Tobago is another example of a Commonwealth country with an upstream natural gas sector that illustrates all three of the following: (1) repeated challenges; (2) resilience, in significant part due to supportive leadership and policy from the government, in response to those challenges; and (3) volatile levels of production that increase and decrease in line with the government's varying level of success in facilitating higher levels of output, rather than noticeably being affected by global climate change policy discourse.

At the outset of the 2020s, Trinidad and Tobago's level of natural gas production had enjoyed a period of strong growth, but the onset of the Covid-19 pandemic led to interruptions in both immediate levels of production, for operational reasons, and expected future production, as the country's round of offshore blocks competitive bidding was delayed. In a dramatic turnaround from the previous period of growth, May 2021 saw Liquified Natural Gas (LNG) production fall to an 18 year low. Responding to the drop in production in the following month, Energy Minister Stuart Young pledged that production levels would return to pre-Covid 19 levels by the end of 2022. [118]

Moreover, Trinidad and Tobago's production ambition was not limited to merely returning to pre-Covid 19 levels of production but in achieving new production highs. Indeed, by September 2021, a total of seven new natural gas projects had been lined up as "expected to start" by the close of 2025, by which date consultancy firm GlobalData modelled the country as set to account for fully a quarter of natural gas production from all of the Americas bar the USA's contiguous 48 states ("Lower 48"). [119]

Such travails and confident policy responses are not new to Trinidad and Tobago's upstream natural gas sector, albeit the 2020 challenges were different in character than previously encountered. Just as in the previous decade, see below, the policy

[118] Argus Media, 'Trinidad aims for pre-Covid gas levels by 2022' (*AM,* 2021) <https://www.argusmedia.com/en/news/2223239-trinidad-aims-for-precovid-gas-levels-by-2022> accessed 25-Sep-2021

[119] Offshore, 'Trinidad and Tobago steps up gas production' (*Offshore,* 2021) <https://www.offshore-mag.com/regional-reports/latin-america/article/14210128/trinidad-and-tobago-steps-up-gas-production> accessed 25-Sep-2021

response was directed at increasing production levels, responding to economic need/opportunity, and not obviously guided by any climate change imperative to end new upstream petroleum development. Given that the form of petroleum in question is natural gas not oil, just as for Bangladesh, the country's government could point to the rationale that natural gas emits far lower levels of GHG than oil, and could therefore be considered even a boon to achieving a *lower* GHG global energy transition.

Yet, that is neither the end of the story nor its start. Rather it is a part of a pattern of cyclical reductions and increases in natural gas production levels. Notably, GlobalData expects the country's production levels to start falling as of 2025 once more unless significant gas production from deep-water acreage can be achieved (with successful exploration needed first) alongside the shallow water blocks already licensed.[120]

The previous decade illustrates a similar narrative of falling production arrested by government intervention and proactive policymaking, leading to production levels bottoming out and then increasing significantly – but only for a short time.

In 2010 Trinidad and Tobago achieved its highest level of annual natural gas production to date. The massive Macondo oil spill in the Gulf of Mexico led BP to conduct extensive planned maintenance to its Trinidad and Tobago production facilities, leading to an immediate reduction in production levels. This event followed two years (2008 – 2010) of significant under-investment, as measured by the levels of such expenditure required to maintain previously-achieved production levels in the country's natural gas sector, and a downward trend in production levels followed. In response, the government mobilised to counter this decline, targeting fiscal changes.

First, it made a commitment of no increased taxation in 2011, and then enacted a series of fiscal changes between 2011 and 2014 to increase the investment attractiveness of the country's natural gas sector. As noted by the Minister of Energy during that time period, Kevin Ramnarine, "one major policy intervention was the introduction of 'accelerated capital allowances' which allowed companies to recover their exploration and developmentally related capital expenditures at a faster rate thus improving the net present value and internal rate of returns of investments." Further to the introduction of these accelerated capital allowances, and almost immediately thereafter, the Juniper natural gas project was given commercial sanction, at $2.1bn USD representing the largest ever single International Oil Company investment in Trinidad and Tobago's upstream petroleum sector. As for the upstream petroleum sector in general, any increase in investment is only likely to result in enhanced levels of production after a time lag elapses, and the policy changes that the government made in the first half of the decade resulted, finally, in increasing levels of natural gas

[120] OilNow, 'Trinidad & Tobago will dominate natural gas production in 2025 but output will be on decline – GlobalData' (*OilNow,* 2021) <https://oilnow.gy/featured/trinidad-tobago-will-dominate-natural-gas-production-in-2025-but-output-will-be-on-decline-globaldata/> accessed 25-Sep-2021

output in 2017 and 2018, with annual declines recorded in each year from 2011 to 2016 inclusive. Production levels in 2019 were similar to the previous year, with a decline following in 2020 alongside the global Covid-19 pandemic reaching the country.[121]

Overall, the volatility of Trinidad and Tobago natural gas production levels year-on-year illustrates the challenges faced by the government and operators alike in achieving sustained growth in extraction levels or stabilising higher levels of production once they had been achieved. Forecast levels of production between now and 2024 are only forecasts and hence subject to uncertainty. Even if realised, all things being equal, those same forecasts project a decline in production in 2025 as compared to the previous year. Nevertheless, the expected levels of increase between now and 2024 are impressive, and the 25% figure of all Americas' (bar that from the USA Lower 48) natural gas production is arresting. Despite the volatility, the sector appears highly resilient, with that resilience demonstrated by its ability to "bounce back" from periodic declining levels of production with yet new forecast highs in natural gas production.

Trinidad and Tobago – Petroleum Preference

What is also evident from the above is the lack of any obvious ambition for the country to divest from new natural gas investment or future upstream development. In fact, the reverse is true: the revealed preference of the country is to invest in yet more such development, not divest and close.

This objective is pursued diligently and demonstrates a very visible and constant struggle to maintain, at a minimum, or increase, ideally, natural production that seems entirely divorced from any active government policy of petroleum divestment in the face of the global climate emergency. The country's NDC commits the country to reduce its GHG emissions from its three most polluting sectors by 15% overall by 2030 and by 30% in the public transportation sector by the same date (see Annex 2 below).

Trinidad and Tobago – Transition Risk

The below data suggests a reason for this dogged determination of Trinidad and Tobago with respect to its petroleum sector.

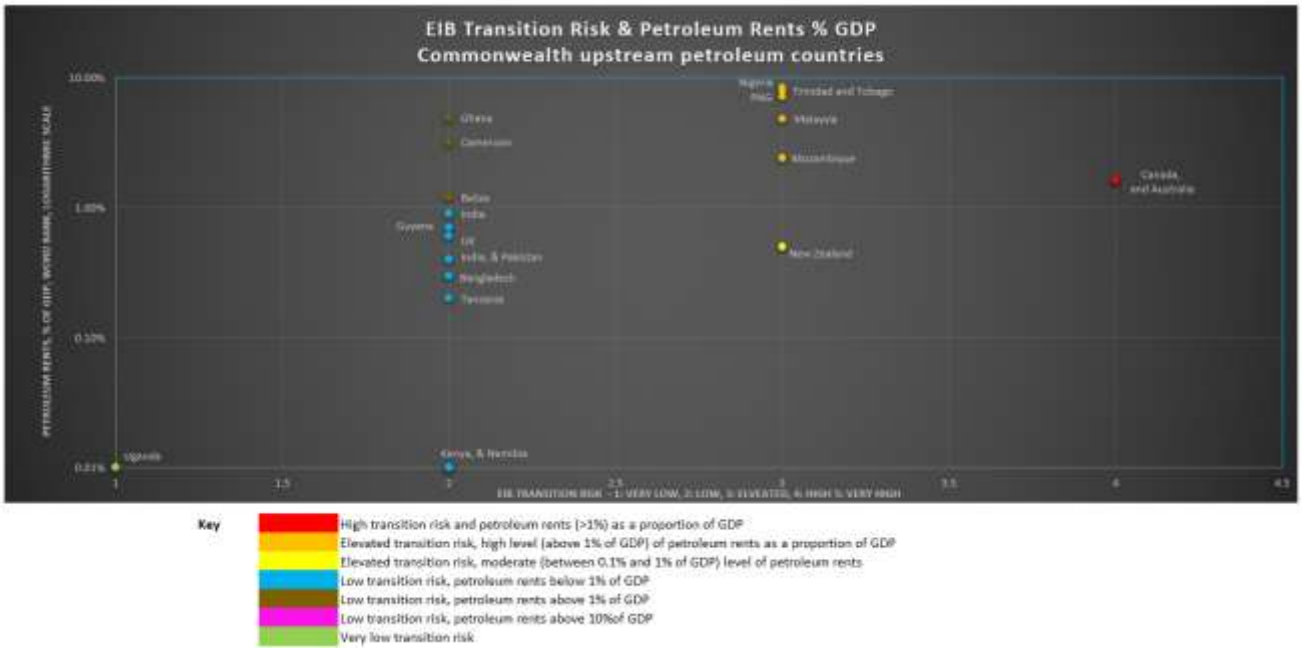
Figure 6[122], below, plots petroleum rents as a percentage of GDP and European Investment Bank (EIB) identified "Transition Risk", namely the risk to a country's

[121]Kevin Ramnarine, 'Trinidad and Tobago's Oil and Gas Sector in a Changing World (2010–2019)' in Peter Cameron and others (ed), *The Global Energy Transition* (Bloomsbury Publishing 2020), 311-326.

[122] Figure 5 above relies on EIB Transition Risk scores which the EIB are currently (September 2021) reviewing. Additionally, ahead of the EIB releasing tabulated, as opposed to graphical, data it is not possible to discern even the existing EIB Transition Risk scores for Commonwealth (and any other) countries of small geographical size, notably this includes the important Commonwealth petroleum extracting state of Brunei Darussalam, which therefore does not form part of Figure 4. The authors of this article look forward to updating its contents once a full and updated set of EIB Transition Risk data is published.

economy of undergoing a low/no Greenhouse Gases (GHG) energy transition away from fossil fuels, e.g. petroleum. The Figure additionally shows different categories of Transition Risk levels. Trinidad and Tobago is shown as having an "Elevated" level of transition risk, reflecting the importance of its natural gas sector to the national economy, see below. Should there be any "end to oil and gas", Trinidad and Tobago will suffer economically, representing a cost that would need to be made up for by realising green energy transition benefits, e.g. from offshore wind-generated around the Caribbean country's islands.

Figure 6



Trinidad and Tobago – Summary

Does the Trinidad and Tobago case study suggest a climate-compatible pathway that also supports economic growth? The answer is positive only insofar as natural gas is considered as an acceptable, in climate terms, "transition fuel" that helps bridge the world to an environmentally and climatically sustainable future. It certainly does not suggest a global end to petroleum, but rather the reverse, an ongoing commitment to upstream petroleum development – specifically natural gas. All this despite the status of the low-lying island of the country that suggests a high level of physical risk from climate change, in particular rises in the sea level but also extreme weather events such as the cyclones and hurricanes that are seasonal (and increasingly extreme) events in the Caribbean.

Conclusions

In the context of climate change as an existential threat to humanity, what are the challenges with respect to Commonwealth countries' oil and gas production, and what does the evidence from this paper's five Commonwealth country case studies say about whether upstream petroleum production is coming to an end or not?

Nigeria's VP Yemi Osinbajo identifies (2021) below one formulation of the climate change/ upstream petroleum challenge, as follows:[123]

> *"Although all countries must play their part in the fight against climate change, a global transition away from carbon-based fuels must account for the economic differences between countries and allow for multiple pathways to net-zero emissions. For countries such as my own, Nigeria, which is rich in natural resources but still energy poor, the transition must not come at the expense of affordable and reliable energy for people, cities, and industry. To the contrary, it must be inclusive, equitable, and just—which means preserving the right to sustainable development and poverty eradication, as enshrined in global treaties such as the 2015 Paris climate accord*."

The concept of "multiple pathways to net-zero emissions" is concordant with the central *modus operandi* of the COP-21/Paris Agreement, whereby climate change targets are specified individually by the 191 parties (as of mid-October 2021)[124] to that agreement, as part of an overall drive to limit temperature change to an increase of no more than 1.5° C, ideally, or at most 2° C of pre-industrial levels. That approach has the benefit of flexibility but the possibility of climate ambition being effectively circumcised through a Tragedy of the Commons[125] dynamic.

The evidence of this paper's Commonwealth case studies clearly shows both dynamism and the extent of the climate action ambition of each upstream petroleum Commonwealth country critically analysed. The fact of each of these countries being current petroleum producers is highly salient since it recognises and reflects the material interest in ongoing upstream production across the world. This fact exists alongside the existential threat to humanity of global climate change, change that could feasibly become irreversible if sufficient mitigating action is not taken urgently.

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[123] Foreign Affairs 'The Divestment Delusion, Why Banning Fossil Fuel Investments Would Crush Africa' (*FA*, 2021) < https://www.foreignaffairs.com/articles/africa/2021-08-31/divestment-delusion> accessed 13-Nov-2021

[124] UNFCCC 'Paris Agreement – Status of Ratification' (*UNFCCC*, 2021) < https://unfccc.int/process/the-paris-agreement/status-of-ratification> accessed 13-Nov-2021

[125] Garrett Hardin, 'The Tragedy of the Commons' (1968) 162 Science 1243

Case Studies

The UK: This is the only developed country case study of this Research Insight. Whilst the country demonstrates very considerable climate action ambition and has demonstrably decoupled its real GDP growth from its CO_2 emissions, the country's upstream petroleum output has plateaued rather than entered any self-evident process of termination. Both forms of petroleum (oil and gas) remain important for the country regarding extraction and consumption, now and in the foreseeable future.

Bangladesh: Nor is there any convincing sign of an end to petroleum to be drawn from the Bangladesh case study. Indeed, its net-zero pathway prioritises natural gas as a viable and at-scale alternative to coal, a fossil fuel with much higher levels of GHG emissions (see above). Topographically low-lying Bangladesh is both a country at extreme risk from climate change and one that requires greater levels of downstream energy supply to provide (quoting the challenge of VP Osinbajo above) more "affordable and reliable energy for people, cities, and industry." That it has decided to switch away from coal as its primary energy source is, in climate action policy terms, greatly to be welcomed. However, the final (thus far) choice of transition was natural gas rather than renewable energy represents a real-world reality check for that sector and its public policy advocates.

Pakistan: As noted above, Pakistan's energy policy is driven by costs and energy security, and a concern to improve sectoral governance rather than climate considerations. This country case study is, like that of Bangladesh, for a country facing extreme climate change risk. This risk threatens the livability of the country simply in terms of everyday day-time ambient temperature. Pakistan is heavily reliant on oil for its downstream energy generation, a higher GHG emitting fuel than natural gas.

Cameroon: For Cameroon, a combination of (geographically specific) physical insecurity, in combination with geological and resource exhaustion constraints, are the identified major drivers for the contraction of its upstream petroleum sector, rather than climate ambition. Indeed, public policy remains highly supportive of enhanced levels of upstream production, should that be achievable. As with its neighbour, Nigeria, Cameroon "is rich in natural resources but still energy poor", and its public policy imperatives on energy are in many ways aligned to those set out for Nigeria by its VP Yemi Osinbajo above. Since peace and security are also laudable and widely shared public policy objectives, alongside climate action, Cameroon as a case study offers no desirable pathway to the global tapering down of upstream petroleum production, let alone its cessation.

Trinidad and Tobago: The case study of Trinidad and Tobago demonstrates a country constantly striving to adjust its public policy and innovate, e.g. with respect to fiscal policy, to encourage the expansion of its upstream petroleum sector, especially natural gas. For Trinidad and Tobago the geological reality of resource exhaustion is

a major limiting factor within the foreseeable future. However, and in common with the case studies above, this does not realistically presage the end(ing) of upstream oil and gas since: globally, plentiful further sources of petroleum remain unextracted; the concept of oil and gas "reserves" is price-specific, i.e. if prices rise so too do the level of resources as "resources" are reclassified as economically viable "reserves"; and the fact of ongoing technological innovation is constantly acting as a driver in exactly this reclassification of resources to reserves through its effect of reducing costs of extraction. Even if Trinidadian extraction falls, this does not suggest, therefore, that global petroleum extraction will fall (or at least, not by any more than the absolute level of Trinidad's falling output), since that country's reduction would be due to the specific fact of resource extraction rather than as a result of any climate action policy imperative trumping economic self-interest from further/ expanded upstream petroleum production. Again, the Trinidadian case study confirms in outlook the revealed choice of developing countries for energy projects with perceived strong development outcomes, even if this means the production of yet more fossil fuel energy sources.

Discussion

As Mahatma Gandhi observed, "we but mirror the world. All the tendencies present in the outer world are to be found in the world of our body. If we could change ourselves, the tendencies in the world would also change."[126] How can this dictum be applied to Commonwealth countries which, in sum, account for *c.* one-third of the world's population?

Just as technological innovation is often the means by which the economic life of an oil/gas field is extended, so to innovation in nuclear energy technology may form part of the answer to achieving the deep and sustainable cuts now required, not least morally, to global GHG emissions. The Pakistani case study above provides this paper's primary evidence for how and why that optimism may be realistic, building on its existing nuclear fleet and collective civil nuclear capacity. Similar optimism can also be identified in the case of the UK, which, through state support and encouragement for the domestically headquartered company, Rolls Royce, is actively pursuing a multiple small nuclear energy generating reactors strategy that is complementary to its large-scale nuclear fleet – both already in operation and currently under development. Outside of the Commonwealth but an immediate neighbour to the UK, France is a leading nuclear energy generating country that similarly pursues this small nuclear energy reactors strategy complementary to its (very extensive) large-scale reactors nuclear fleet. Within the Commonwealth and a case study country above, Bangladesh has clearly stated its ambition to develop its own civil nuclear programme as a route both to helping it generate more downstream energy to better meet its citizens' needs, and to achieve the wholly decarbonised energy transition that it has explicitly committed itself to.

[126] Gandhi, *Collected Works of Mahatma Gandhi, Vol. XIII*

For other Commonwealth countries, including non-nuclear Commonwealth case study countries Cameroon and Trinidad & Tobago, a transition to renewable energy from petroleum can be viable if encouraged and enabled sufficiently. Most obviously from these case studies, for Bangladesh, public policymakers only selected natural gas as the primary and strategic fuel to support the country's development on the practical and pragmatic grounds of cost and reliability. Global investment both in technological innovation and the enhanced supply of necessary raw material inputs can help to close that gap, allowing climate ambitious countries such as Bangladesh to commit themselves far more fully to an energy transition to renewable energy rather than the half-way house of natural gas.

Next Steps

For countries where upstream petroleum production (both current and potential) is economically more significant than is the case for Bangladesh, as is notably so for both the Cameroonian and Trinidadian case studies, there will be an additional "just transition" hurdle to jump for upstream petroleum production to be reduced or even terminated in preference to economic diversification and the replacement by renewable energy of these fossil fuels (especially natural gas) for domestic use. For that to be achieved, at-scale financing and technology transfer by the developed world must be provided to these countries, reaching beyond the COP 21 Paris Agreement levels that remain substantially unrealised, to specifically facilitate such a transition. Without such a large-scale intervention, mirroring that of the post-war Marshall Plan for Europe, any expectations of such a transition in the near term would seem forlorn.

Such developed world investment and technology transfer would also catalyse the green energy transition away from petroleum in developing countries e.g. in the case of Bangladesh; indeed, the results in such countries are likely to be even more impressive given their current propensity to welcome the switch from fossil fuels to renewable energy, should they be practically afforded the opportunity to do so at scale.

In sum, whilst these Commonwealth case studies suggest that no end to oil/ gas extraction is as yet imminent, *they also illustrate how such a policy end could be achievable*, through varied pathways, should the means be willed to effect it.

As Saudi Arabia's former Petroleum Minister Sheikh Zaki Yamani remarked that "The Stone Age did not end for lack of stone, and the Oil Age will end long before the world runs out of oil."[127] Ultimately, the petroleum age will only end when we collectively wish strongly enough for it to do so, including providing the hard cash required to make that a reality, not just an aspiration reflected upon in a set of heterogenous, often frustratingly vague, COP-21 NDCs.

[127] The Economist 'The End of the Oil Age' (*Economist,* 2003) <https://www.economist.com/leaders/2003/10/23/the-end-of-the-oil-age> accessed 13-Nov-2021

Selected Glossary of Terms

(Anthropogenic) Climate Change: a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

Climate Change Adaptation: in human systems, adaptation is the process of adjusting to actual or anticipated climate and its effects to mitigate harm or capitalise on beneficial opportunities. It is the process by which natural systems adapt to actual climate and its effects - human intervention may facilitate adaptation to expected climate.

Climate Change Mitigation: human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Greenhouse Gases (GHGs): gaseous constituents of the atmosphere, both natural and anthropogenic, which absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, by the atmosphere itself, and by clouds - this property causes the greenhouse effect.

Nationally Determined Contributions (NDCs): country notified plans highlighting action on climate change, including climate related targets, policies and measures governments aims to implement in response to climate change and as a contribution to global climate action. They are actions in the Paris Agreement to contribute to international efforts to keep increases in global temperature below 2 degrees Celsius, with respect to pre-industrial levels, preferably that in a limit of 1.5°C.

Land Use, Land Use Change and Forestry (LULUCF): "GHG inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use such as settlements and commercial uses, land-use change, and forestry activities."[128]

Reducing Emissions from Deforestation and forest Degradation, plus enhancement of forest carbon stocks (REDD+): climate change action focused on forests.

Source: *United Nations Framework Convention on Climate Change (UNFCCC) Intergovernmental Panel on Climate Change*

[128] United Nations Climate Change, 'Glossary of climate change acronyms and terms' (*UNFCC,* 2021) <https://unfccc.int/process-and-meetings/the-convention/glossary-of-climate-change-acronyms-and-terms#l> accessed 25-Sep-2021

Annexes

Annex 1: Upstream Petroleum Countries of the Commonwealth

No.	Country Name	Commerciality, or Producer (Natural Gas[129] / Oil[130])
1	Australia	Producer
2	Bangladesh	Producer
3	Barbados	Producer
4	Belize	Producer
5	Brunei Darussalam	Producer
6	Cameroon	Producer
7	Canada	Producer
8	Cyprus	Commerciality: Aphrodite natural gas commercial discovery, 2015[131]
9	Ghana	Producer
10	Guyana	Producer
11	India	Producer
12	Kenya	Producer[132]
13	Malaysia	Producer
14	Mozambique	Producer
15	Namibia	Commerciality: Kudu natural gas field commercial discovery, 1974[133]
16	New Zealand	Producer
17	Nigeria	Producer
18	Pakistan	Producer
19	Papua New Guinea	Producer
20	Tanzania	Producer
21	Trinidad and Tobago	Producer
22	Uganda	Commerciality: Lake Albert (Tilenga and Kingfisher) oil projects, FID, 2021[134]
23	UK	Producer

[129] World Bank, 'Natural Gas Rent (% of GDP)' (*World Bank,* 2021) <https://data.worldbank.org/indicator/NY.GDP.NGAS.RT.ZS> accessed 25-Sep-2021

[130] Ibid

[131] Offshore Energy, 'Aphrodite gas discovery declared commercial (Cyprus)'

[132] Joseph Akwiri, 'Kenya's first crude oil export sparks demands over revenue sharing' (*Reuters,* 2019) <https://www.reuters.com/article/us-kenya-oil-idUSKCN1VG1FQ> accessed 25-Sep-2021

[133] Shakwa Nyambe; Shafimana Shimakelwni, 'Energy Oil & Gas 2021: Namibia - Trends and Developments' (*Chambers and Partners,* 2021) <https://practiceguides.chambers.com/practice-guides/energy-oil-gas-2021/namibia/trends-and-developments/O8749> accessed 25-Sep-2021

[134] Hydrocarbons Technology, 'Total, partners finalise agreements to launch Lake Albert project' (*HCT,* 2021) <https://www.hydrocarbons-technology.com/news/uganda-tanzania-total-cnooc-lake-albert/> accessed 25-Sep-2021

Annex 2: Summary of Nationally Determined Contributions of selected countries

NDC Status by Country	Climate Impacts	Priority Objectives/ Target	Policies and measures	Mitigation Commitment	Adaptation Commitment
Australia 1st NDC (With 2020 Communication)		Economy-wide target to reduce greenhouse gas emissions by 26 to 28 % below 2005 levels by 2030.	National Energy Productivity Plan with a Target of a 40% improvement between 2015 and 2030; Deployment of new and emerging low-emissions technologies.	26% to 28% below 2005 levels by 2030, to be implemented as an emissions budget covering the period 2021-2030. Sectors: Energy; Industrial processes and product use; Agriculture; Land-use, Land-use change and forestry; Waste.	Investing in climate adaptation to build resilience and adapt to the challenges of a changing climate, both domestically and regionally.
Bangladesh 1st NDC (Updated 26/8/21)	Susceptible to seasonal cyclones; facing floods, storm surges, drought, and riverbank erosion.	Two-fold strategy. The focus is on increasing resilience to the impacts of climate change; but also, to achieve lower carbon and more resilient development.	20% reduction in energy intensity by 2030 vis-à-vis 2013; Energy Management Programme; Built Environment Energy Efficiency; Solar Homes Programme etc.	Unconditional GHG emissions reduction by 6.73% below Business as Usual (BAU) in 2030 in the energy, agriculture, transport, industry & waste sectors etc; Conditional GHG emissions reductions by 15.12% below BAU in 2030 in the respective sectors.	Improved Early warning system for tropical cyclone; Disaster preparedness; Climate resilient housing; Research; Capacity Building, etc.
Barbados 1st NDC (Updated 2021)	Rising temperatures; increasing extreme weather events; rising sea levels; increasing coral bleaching events; Indirect impacts e.g. drought, flooding, pest outbreaks, illness.	To achieve an economy-wide reduction in GHG emissions of 44% compared to its BAU scenario by 2030. To ensure a protected environment, a stable society and a sustainable and resilient economy. To be, by 2030, the first 100% green and fossil-fuel free island-state in the world.	The 2021 Physical Development Plan Amendment will provide the framework for government decision-making across several key areas of development with a direct impact on climate change mitigation and adaptation.	Reduce electricity consumption; Increase renewable energy supply and demand; A fossil-fuel free electricity sector; Clean transport; Institutionalise a formal Monitoring, Reporting and Verification (MRV) system to track national emissions and the impact of specific mitigation actions.	Manage freshwater resources; Improve agricultural productivity; Prevent land degradation; Focus on agriculture, tourism, fisheries, human health, coastal resources, and human settlements; Include youth and gender considerations in adaptation.

Belize 1st NDC (Updated 2021)	Sustained droughts, floods, increased coastal erosion and changing precipitation patterns. Vulnerabilities include flooding of Belize City, crops and livestock harm etc.	Avoid cumulative emissions total of 5,647 Kiltonnes (Kt) CO2 equivalent (eq) between 2021 and 2030. e.g. 63% increase in GHG removals related to the LULUCF. To build resilience and develop capacity to adapt to the impacts of climate change in key economic sectors and supporting systems.	Sectoral targets and actions. To strategically transition to low carbon development while strengthening its resilience to the effects of climate change (as specified in Belize's National Climate Change Policy, Strategy and Action Plan).	Conserve and protect biodiversity, land and forests through community resource management; Improve public transportation by upgrading fleet and promoting the use of biofuels; Facilitate clean production systems in processing agricultural and forestry outputs to co-produce biofuels.	Sustainable management of fisheries and aquaculture; Build resilience of settlements and coastal zone; Integrate adaptation planning into the tourism sector; Enhance resilience in the transport sector; Improve adaptive capacity in health sector; Agricultural sector etc.
Brunei Darussalam 1st NDC (2020)	Rise in temperatures; rainfall; drought, flash floods, etc affect health, lives, wildlife & diversity, food security.	To reduce in GHG emissions by 20% relative to Business-As-Usual levels by 2030. (Key sectors covered: Energy, Industrial Processes and Product Use, LULUCF.	Brunei Darussalam National Climate Change Policy Strategy 8 on Climate Resilience and Adaptation; Ministry of Development has implemented a series of flood mitigation works along the coastal area of Brunei Darussalam etc.	Reduce overall emissions in the Industrial Sector; Increase carbon sink through afforestation and reforestation; Increase total share of electric vehicles (EV) to 60% of the total annual vehicle sales by 2035; Increase total share of renewable energy to at least 30% of total capacity in the power generation mix by 2035; Reduce GHG emissions by at least 10% through better supply and demand management of electricity consumption by 2035; Impose price on carbon emissions for industrial sector; Reduce municipal waste to landfills Mandatory monthly and annual reporting of carbon inventory.	Strengthen resilience against climate change risks and increase adaptive capacity e.g. through enhancing and integrating climate science findings into policies, conducting climate impact assessments and consideration of nature-based solutions as an option to increase resilience.

Cameroon 1st NDC (2016)	Climate vulnerability in key sectors – e.g. agriculture; fisheries, forestry; water, sanitation and health; urban development and public works; energy; mines and industries.	32% reduction in GHG emissions compared to a scenario of benchmark for the target year (2035), and conditional on community support.	Cameroon intends to reduce the carbon footprint of its development without slowing down its growth, by favouring mitigation options with high co-benefits. National Plan for Adaptation to Climate Change of 2015.	Greening (intensification, sedentarization) of agriculture and forestry management; increase in energy supply and improvement of energy efficiency: 25% of renewable energy in the electricity mix by 2035; Waste management; Rehabilitation of degraded lands and the reforestation of savannas; develop basic infrastructure that will improve logistics, transport of agricultural, livestock and fish farming products etc.	Improve knowledge on climate change; inform, educate and mobilize the Cameroonian population to adapt to climate change; educing vulnerability to climate change in main sectors and agro-ecological zones of the country; Integrate adaptation to climate change into national sector strategies and policies.
Canada 1st NDC (Last updated 2021)	Increased health risks due to extreme heat and prevalence of infectious diseases; Isolated and marginalized communities particularly vulnerable to climate change impacts, such as repeated and severe flooding.	Reduce GHG emissions in 2030 by at least 40-45% below the base year's emissions; To reduce emissions to net-zero by 2050; To respect, promote and consider obligations on human rights, the rights of Indigenous Peoples, gender equality and other cross-cutting priorities; Transition to a net-zero emissions economy in a way that promotes economic diversification and jobs.	NDC target covers all of Canada's economic sectors and all major GHGs not covered by the Montreal Protocol. Priority sectors: Agriculture, energy, industrial processes and product use, LULUCF, and waste.	Protect and enhance carbon sinks, including in forests, wetlands and agricultural lands; Invest in clean energy technology to ease the transition to a low carbon economy; Regulate emissions of various GHGs and hydrofluorocarbons. Also: mitigation co-benefits deriving from Canada's national adaptation actions.	Making the Places Canadians Live and Gather More Affordable by Cutting Energy Waste; Making Clean, Affordable Transportation and Power Available in Every Canadian Community; Embracing the Power of Nature to Support Healthier Families and More Resilient Communities; Indigenous Climate Leadership; Gender Action Plan to further advance women-led and gender-responsive climate action at national and multilateral levels. (A Healthy Environment and a Healthy Economy - Canada's Strengthened Climate Plan, 2020).

Cyprus 1st NDC (Updated 2020) **(NB: this is the European Union (EU) NDC, as Cyprus is an EU Member State)**		The target of a net domestic reduction of at least 55% in GHG emissions by 2030 compared to 1990.	Economy-wide net domestic GHG emission reduction (Sectors: Energy, Industrial processes and product use, Agriculture, Waste, LULUCF); Gender equality and cross-cutting priorities, e.g. indigenous communities; Recognising the exceptional nature of the economic and social situation due to the Covid-19 crisis.	Increase renewable energy in final energy consumption to reach at least 32% by 2030; Reduce carbon emission from road transport; tightening landfilling and recycling targets and increasing the circularity of the EU economy, etc.; Creating a Just Transition Mechanism, including a Just Transition Fund	Sustainable and resilient recovery from the Covid-19 crisis; Use of nature-based solutions to play an important role to solve global challenges such as biodiversity loss and ecosystems degradation, poverty, hunger, health, water scarcity and drought, gender inequality, disaster risk reduction and climate change
Ghana 1st NDC (2016)	Climate change vulnerability	To unconditionally lower GHG emissions by 15 relative to a BAU scenario emission of 73.95 Mt CO_2eq 2 by 2030. To increase climate resilience and decrease vulnerability for enhanced sustainable development.	The implementation of actions to help attain low carbon climate resilience through effective adaptation and greenhouse gas (GHG) emission reduction in priority sectors: These include: Sustainable land use including food security; Climate proof infrastructure; Equitable social development; Sustainable mass transportation; Sustainable energy security; Sustainable forest management; and Alternative urban waste management.	Scale up renewable energy penetration by 10% by 2030; Promote clean rural households lighting; Expand the adoption of market-based cleaner cooking solutions; Double energy efficiency improvement to 20% in power plants; Scale up sustainable mass transportation; Promote Sustainable utilization of forest resources through REDD+; Adopt alternative urban solid waste management; Double energy efficiency improvement to 20% in industrial facilities; Green Cooling Africa Initiative.	Agriculture resilience building in climate vulnerable landscapes; Value addition-based utilization of forest resources; City-wide resilient infrastructure planning; Early warning and disaster prevention; Managing climate-induced health risk; Integrated water resources management; Resilience for Gender and the Vulnerable.

Guyana **1st NDC (2016)**	Vulnerability of agriculture to rising sea levels.	Sustainable forest management; Power all newly established townships with renewable energy.	Focus on the forest and energy sectors, where the majority of current and historic emissions are produced.	Increase share of renewable energy by 100% by 2025; Address emissions from mining and logging activities in the country.	Continue the construction, rehabilitation, and maintenance of conservancies and canals; Prioritize water supply and sanitation; Introduce new agricultural techniques such as hydroponics and fertigation.
India **1st NDC (2016)**	Population faces large scale climate variability and are exposed to enhanced risks from climate change – affects agrarian economy, its expansive coastal areas and the Himalayan region and islands.	To establish an effective, cooperative and equitable global architecture based on climate justice and the principles of Equity and Common but Differentiated Responsibilities and Respective Capabilities, under the UNFCCC. To reduce the emissions intensity of its GDP by 33 to 35% by 2030 from 2005 level.	National Environment Policy 2006; National Action Plan on Climate Change; State Action Plan on Climate Change; The Energy Conservation Act; Integrated Energy Policy; The National Policy for Farmers; National Electricity Policy.	Clean and efficient energy system; Enhancing energy efficiency in industries; Developing climate resilient urban centres; safe, smart and sustainable green transportation network; Planned afforestation; Abatement of pollution; Citizens and private sector contribution to combating climate change.	Adaptation policies in key sectors. These include - sustainable management of agricultural systems; enhancing efficient use of water & ensuring access; strategies for mitigating, containing and managing the adverse impact of Climate Change on health; Coastal Regions & Islands management; holistic disaster management; Protecting Biodiversity & Himalayan Ecosystem; Rural livelihoods security; Integrating adaptation actions under state action plans on climate change; knowledge management & capacity building.

Kenya 1st NDC (Updated 2020)	Drought, Heat waves, Floods, leading to food insecurity, sea level rise, conflict, loss of lives and livelihoods etc.	Abate GHG emissions by 32% by 2030 relative to the BAU Scenario 143 Mt CO_2eq. To ensure a climate resilient society – through mainstreaming climate change adaptation into medium term plans & Country Integrated Development Plans & Implementing adaptation actions.	Kenya Vison 2030; National Climate Change Response Strategy, 2010 – Integration of climate change mitigation and adaptation in all government planning and development. Emphasis on mitigation co-benefits of adaptation actions. NB: Kenya's NDC notes that the country will need significant international support to forego all the benefits of fossils e.g. oil, gas, and coal.	Increase renewables in electricity generation mix; Energy and resource efficiency; achieve tree-cover of at least 10% of land area; land degradation neutrality; scaling up nature-based solutions for mitigation; REDD+ activities; sustainable energy technologies; climate smart agriculture; low carbon transport systems; sustainable blue economy & sustainable waste management systems etc.	Enhancing adaptive capacity & resilience across sectors; innovative livelihood strategies to enhance resilience of local communities; enhance risk-based approach to adaptation; address residential climate change impacts; more investment in ocean blue economy; enhance uptake of adaptation technology by women, youth, vulnerable groups.
Malaysia 1st NDC (Updated 2021)	Increased incidences of natural disasters - from temperature rise &seasonal monsoon floods; Effects on water & food security; Health; Coastline erosion.	To unconditionally reduce economy-wide carbon intensity (against GDP) of 45% in 2030 compared to 2005 level.	Economy-wide NDC to include all key categories of anthropogenic emissions and removals.	Economy-wide GHG emission reductions in – Energy, Industrial Processes and Product Use, Waste, Agriculture, LULUCF.	Focus on the management of water resources and security, coastal resources, agriculture and food supply, urban and infrastructure resilience, public health, forestry and biodiversity and key adaptation cross sectoral areas.

Mozambique 1st NDC (2018)	Increase of the frequency and intensity of drought, floods & tropical cyclones. These lead to loss of human lives, destruction of socioeconomic infrastructures and property, loss of livelihoods and environmental degradation etc.	To increase resilience in the communities and the national economy including the reduction of climate risks and promote a low carbon development and the green economy through the integration of adaptation and mitigation in sectorial and local planning.	National Climate Change Adaptation and Mitigation Strategy (Ministry for the Coordination of Environmental Affairs, 2012); Second Phase of the Technology Needs Assessment Project, covering energy; waste; agriculture; coastal zones, & infrastructures.	Total reduction of about 76,5 MtCO2eq in the period from 2020 to 2030, with 23,0 MtCO2eq by 2024 and 53,4 MtCO2eq from 2025 to 2030. (conditional on the provision of financial, technological and capacity building from the international community); Identified actions are related to energy (electricity production, transports and other – residential, commercial and institutional), land use, land use change and forestry (REDD+) and waste (solid waste disposal and treatment).	Early warning system and of the capacity to prepare and respond to climate risks; Integrated water resources management; Land use and spatial planning (protection of floodplains, coastal and other areas vulnerable to floods); Resilience of agriculture, livestock and fisheries; Adaptive capacity of the most vulnerable groups; resilient climate resilience mechanisms for infrastructures etc.
Namibia 1st NDC (Updated 2021)	Vulnerability to flooding and droughts.	To reduce GHG emissions by 91% (14% unconditional part, and 77% conditional part) by 2030 compared to BAU.	National Climate Change Policy of 2011 and the National Climate Change Strategy and Action Plan 2013-2020, aimed at building the country's adaptive and mitigative capacities.	National climate change strategy and action plan for the period 2013-2020, with two mitigation themes: sustainable energy and prioritized low carbon development, and transportation.	More focus on adaptation - implemented under four key critical themes, that is, food security and sustainable biological resources; sustainable water resources base; human health and wellbeing; and infrastructure development. Focus on agriculture, tourism and fisheries sectors; Gender-balanced training and the promotion of the youth and women.

New Zealand 1st NDC (Updated 2020)		To reduce GHG emissions to 30% below 2005 levels by 2030; To reduce net emissions of GHGs (other than biogenic methane) to zero by 2050, and to reduce emissions of biogenic methane to 24 to 47% below 2017 levels by 2050, including to 10% below 2017 levels by 2030.	Climate Change Response (Zero Carbon) Amendment Act, 2019; Established Climate Change Commission in December 2019 to provide expert advice and monitoring. Use of market mechanisms and cooperative approaches.	Economy-wide GHG emissions reduction e.g. in Energy; Industrial processes and product use; Agriculture; Forestry and other land use; Waste and all greenhouse gases.	To build resilience to the impacts of climate change with a focus on its Pacific neighbours.
Nigeria 1st NDC (Updated 2021)	Extreme events and weather variability – droughts, floods, erosion, sea-level rise.	Unconditional target to reduce GHG emissions by 20% below BAU by 2030; Increase conditional target to 47% below BAU by 2030 on condition of receiving appropriate support.	National Adaptation Plan (NAP) Framework of 2020. NAP underscores significance of sectoral approach to development – Institutional arrangement that follows broader climate change governance.	Action across all sectors – Energy (residential; transport; energy efficiency electricity generation; and oil and gas, notably zero gas flaring by 2030, 60% reduction in fugitive upstream methane emissions by 2031); Agriculture, forestry & land use; Waste – 10% reduction in methane emissions from organic solid waste.	Use of nature-based solutions to bolster water security, enhance food security, mangrove restoration and management etc.; Foster a climate resilient water sector e.g. through adopting integrated water resources management for river basins.
Pakistan updated NDC (2021)	Climate-induced catastrophes – riverine overflows, heavy monsoons, cyclones, droughts and heat waves.	A cumulative ambitious target of overall 50% reduction of its projected emissions by 2030. 15% from country's own resources and 35% subject to international grant.	National Climate Change Policy has been adopted as an integrated approach to build resilience in various climate change sensitive sectors.	Taking adaptation actions through nature-based solutions, land use change and forestry, and community infrastructure, among expanding the use of renewable energy up to 60% by including hydro power, and moratorium on imported coal.	Ecosystem restoration, Ten Billion Tree Tsunami Program, Transforming the Indus Basin with Climate Resilient Agriculture and Water Management; strong risk management system for the agriculture sector; Improving the emergency response etc.

Papua New Guinea (PNG) 1st NDC (2016)	Existential threats to coastal and low-lying areas of PNG and its neighbours; hazards like coastal flooding, inland flooding and droughts take a severe affect people and the economy.	Adaptation is a high priority for PNG. PNG will opt for a national target in the electricity sector in terms of becoming carbon free by a 2030 target date.	NDC quote: "the main burden for any mitigation undertaken by the country must be the responsibility of the developed countries that have been primarily responsible for the bulk of the world's emissions." Risk Management: prioritising and quantifying hazards as listed in PNG's climate changed Adaptation Strategies as specified within its National Climate Change Development Management Policy.	Reducing emissions from land use change and forestry; Reduction of fossil fuel emissions in the electricity generation sector by transitioning renewable energy – Target is 100% renewable energy by 2030, contingent on funding being made available; Improve energy efficiency sector wide and reduce emissions where possible in the transport and forestry sectors. NB: no major mitigation plans for the oil and gas sector for fear of having stranded assets, and the economic importance of the sector.	Emphasis on Coastal Flooding and Sea Level Rise; Inland Flooding; Food Insecurity caused by crop failures due to droughts and inland frosts; Cities and Climate Change; Climate Induced Migration; Damage to Coral Reefs; Malaria and Vector Borne Diseases; Water and Sanitation; Landslides.
Tanzania 1st NDC (Updated July 2021)	Extreme weather events e.g. droughts and floods; Impact on agricultural production, water resources, marine and coastal zones, public health, energy supply and demand, infrastructure, biodiversity, and ecosystem services.	Reduce GHG emissions economy-wide between 30 - 35% relative to the BAU scenario, by 2030	Interventions on adaptation and mitigation, to build country resilience to the impacts of climate change and contribute to GHG emission reduction.	Priority mitigation sectors are energy, transport, forestry, and waste management, e.g. A greater use of natural gas and harnessing renewable energy sources; Consider impacts of climate change in development planning at all levels.	Develop a climate resilient development pathway; Increase access to clean and safe water to 100% by 2030; Specific sectoral measures listed in the NDC, including for: livestock farming, arable farming, forestry, energy, marine environment and fisheries, water, sanitation, and hygiene, tourism, land use and human settlements development, health, infrastructure, and disaster risk reduction.

Trinidad & Tobago 1st NDC (2018)	Acutely vulnerable to hurricanes, flooding, sea-level rise linked to higher temperatures, coastal erosion and loss of coastal habitats and areas of human habitation.	Reduce GHG emissions from its three most polluting sectors by 15% overall by 2030; Reduce GHG emissions by 30% in the public transportation sector by the end of 2030.	National Climate Change Policy, and the Carbon Reduction Strategy for the power generation, transportation and industrial sectors which forms the basis of NDC.	Reduce carbon emissions from power generation, industry, and transportation.	Reduce climate vulnerability in all sectors; enhance national capacity for adaptation to climate change.
Uganda 1st NDC (2016)	Rising mean annual temperatures; reduced annual and seasonal rainfall; Increasing and frequent extreme events e.g. droughts, floods and landslides; Impact on agriculture, water, health and human settlements.	Priority is to reduce the vulnerability of the population, environment and economy by implementing adaptation actions. Also, to "implement strategies, plans and actions for low greenhouse gas emission development" in the context of its development goals.	Ensuring that all stakeholders address climate change impacts and their causes through appropriate measures, while promoting sustainable development and green growth.	Build on existing Clean Development Mechanism projects and Programmes; Policies and measures to support low-carbon development in key priority sectors e.g. Energy, forestry, wetlands, agriculture.	Reducing vulnerability in priority sectors: agriculture and livestock, forestry, infrastructure (with an emphasis on human settlements, social infrastructure and transport), water, energy and health; Disaster risk management.
United Kingdom 1st NDC (Dec 2020)		To reduce economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels.	Builds upon: Ten Point Plan for a Green Industrial Evolution, 2020; Clean Growth Strategy; Programme for Government 2020/21 (Scotland); Prosperity for All: A Low Carbon Wales, 2019 (Wales); and the Strategic Energy Framework 2010-20 (Northern Ireland).	Reduce GHG emissions by 68% in following sectors: Energy (including transport); Industrial Processes and Product Use (IPPU); Agriculture; Land-use, Land-Use Change and Forestry (LULUCF); and Waste.	Sustainable development and poverty eradication; Food security and policy. Developing clean, healthy, safe, productive and biologically diverse ocean and seas; Protecting terrestrial biodiversity; Sustainable lifestyles and sustainable patterns of consumption and production etc.

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