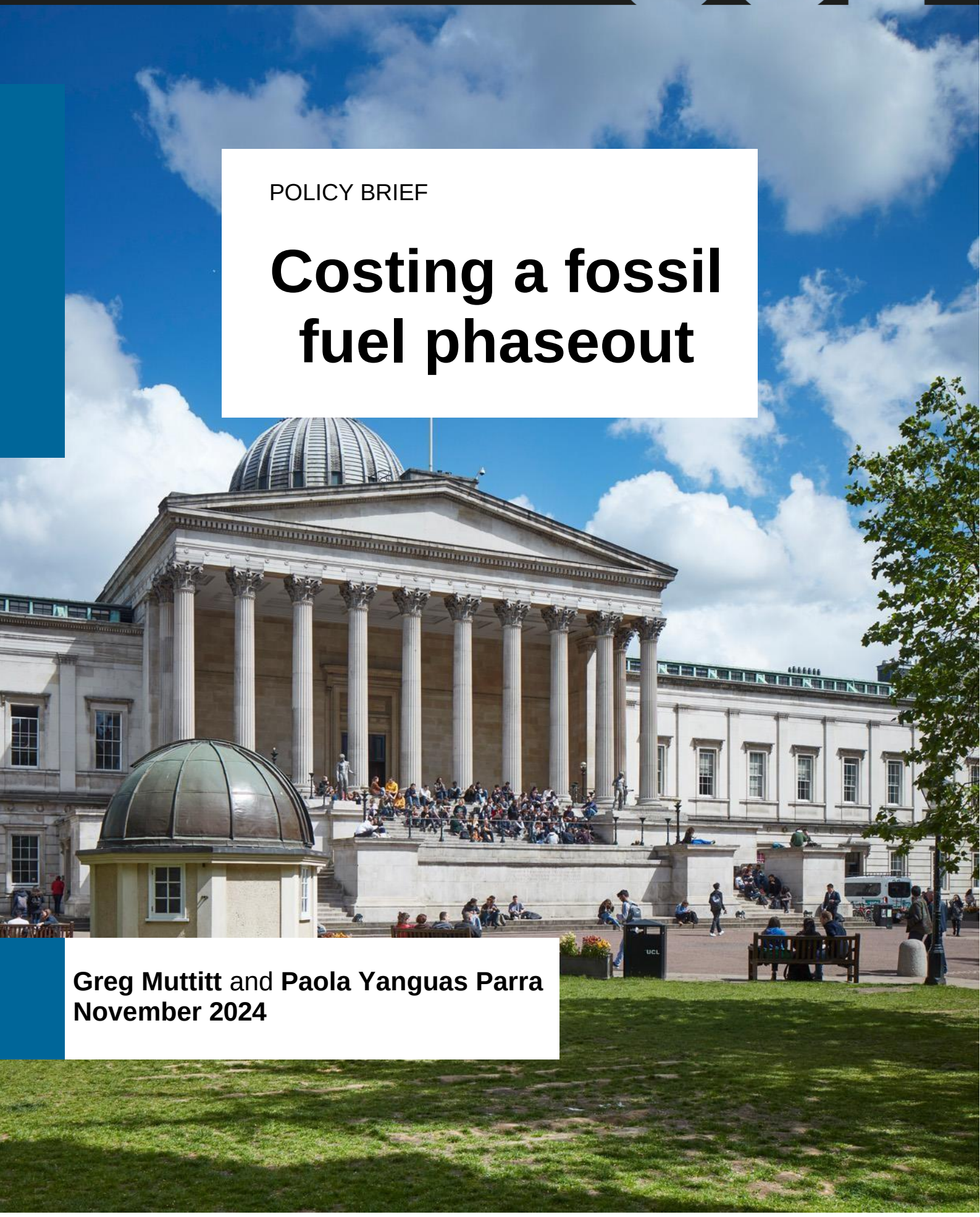
UCL Energy Institute

POLICY BRIEF

Costing a fossil fuel phaseout



Greg Muttitt and **Paola Yanguas Parra**
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Authors

Greg Muttitt is Honorary Research Fellow in the Energy Institute of the Bartlett School of Environment, Energy and Resources at UCL.

Paola Yanguas Parra is Postdoctoral Researcher in the Institute for Sustainable Development of the School of Engineering at Zurich University of Applied Science ZHAW.

Acknowledgments

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The Bartlett School of Environment, Energy and Resources

Summary

At the COP28 climate summit in Dubai in 2023, governments agreed in the Global Stocktake to “transition away” from fossil fuels in energy systems, “in a just, orderly and equitable manner”. As attention turns to implementing that commitment, an important question is the size of the price-tag.

In this policy brief, we outline the expenditures incurred in a fossil fuel phaseout, aiming to provide practical input to structuring the way policymakers approach funding a fossil fuel transition.

- Fossil fuel phaseout involves three types of investments: in clean energy, in alternative sectors to diversify and eventually transform the economy, and in a just transition.
- Bottom-up assessments at a country level will not only give a more accurate picture of the three types of costs, they provide an opportunity for countries to engage in international processes to generate finance. Top-down estimates are necessarily very approximate, but tell us that the total global costs will be of the order of trillions of dollars per year.
- Depending on countries’ circumstances, meeting these costs will entail different shares of domestic resources and international finance. Developing countries need help with these costs, especially given the higher cost of capital in their economies and often already-unsustainable levels of external debt. For these reasons, a significant portion of the investments in developing countries will need to be covered by concessional and grant-based finance, rather than simply leaving it to private sector investment.
- The issue is not only about money, but also about developing the institutional and human capacities to manage the new system and the process of getting there, and removing political and structural barriers to the transition.

Introduction

At the COP28 climate summit in Dubai last year, governments agreed in the Global Stocktake to "transition away" from fossil fuels in energy systems, "in a just, orderly and equitable manner".[1] As attention turns to implementing that commitment, an important question is the size of the price-tag.

A new generation of Nationally Determined Contributions (NDCs 3.0) is due in 2025, where governments will describe their climate plans, reflecting the outcomes of the Global Stocktake. To enable these in developing countries, COP29 at the end of this year will see negotiations on the New Collective Quantified Goal (NCQG) on climate finance.[2] These negotiations will shape the ambition level of the new generation of NDCs.

Building on lessons from the Just Energy Transition Partnerships (JETPs) in South Africa, Indonesia, Vietnam and Senegal, there is now growing interest in country platforms, a mechanism to combine nationally-driven development plans with international finance.[3] For example, Bangladesh launched a platform in 2023 to finance mitigation and adaptation.[4] Colombia recently announced an investment programme of USD 40 billion, to enable the country both to transition away from fossil fuels and to adapt to climate change.[5]

In this policy brief, we outline the expenditures incurred in a fossil fuel phaseout. There is plenty of evidence that the benefits of an energy transition significantly outweigh the costs,[6] however these costs and benefits are unevenly spread among countries. Our purpose here is to provide practical input to structuring the way policymakers approach funding a fossil fuel transition.

Categorising types of phaseout expenditure

There are broadly three categories of spending needed for a transition. First is the investments in creating the new energy system. This includes building renewable energy, heat pumps and insulation in buildings, improving power grids, electrifying transport and transforming industrial processes and fuels. To make it possible, some aspects of infrastructure and urban fabric will need to be transformed. Since all

1 https://unfccc.int/cop28/5-key-takeaways

2 https://unfccc.int/NCQG

3 https://www.phenomenalworld.org/analysis/the-contest-to-shape-country-platforms/

4 https://www.imf.org/en/News/Articles/2023/12/03/bangladesh-launch-climate-development-platform-to-leverage-adaptation-and-mitigation-investments

5 https://www.reuters.com/business/environment/colombia-launches-40-bln-investment-portfolio-energy-climate-transition-2024-09-27/?utm_source=cbnewsletter&utm_medium=email&utm_term=2024-09-30&utm_campaign=Daily+Briefing+30+09+2024

6 https://www.imf.org/en/Blogs/Articles/2023/12/05/benefits-of-accelerating-the-climate-transition-outweigh-the-costs

https://www.iea.org/news/rapid-rollout-of-clean-technologies-makes-energy-cheaper-not-more-costly

countries consume fossil fuels, all will face these costs.

Second, for countries that extract fossil fuels, investments are needed to develop alternative sectors that will replace fossil fuels' role in the wider economy. Some countries' economies depend heavily on fossil fuels to generate government revenues, and as exports to generate foreign currency. These countries will need investments to build sources of government revenues and new sectors to drive the economy. This is particularly the case for regional economies in the fossil fuel extraction regions, which have much higher dependency of the fossil sector than national economies.[7]

Third, spending is needed to manage the transition with minimal disruption. This includes supporting workers, such as through retraining and through providing social protection for them during the transition, and enabling a reorienting of energy value chains. Other transitional costs include dealing with the environmental legacy of the fossil fuel sector, and more broadly reorienting communities and entire regions from economic, social and cultural reliance on fossil fuels. All countries will require just transitions relating to fossil fuel consumption (such as for power station workers); fossil-extracting countries will also need to enable just transitions for extractive industry workers.

All three types of expenditure generate benefits beyond mitigating climate change. A clean energy system is cheaper,[8] reduces harmful air pollution[9] and creates more jobs.[10] A diversified economy is more resilient and prosperous, and less exposed to price swings. and geopolitical disruptions.[11] A just transition ensures quality jobs, democratic engagement, social inclusion and workers' rights.[12]

And it is not just money: a large part of the challenge is political, in overcoming the inertia of the status quo. Governments can start by removing ongoing support for fossil fuels, and creating an enabling environment for clean energy and alternative economic sectors to grow.

We can now look into ways to estimate the costs and needs.

Clean energy investments

Investments in clean energy are the element that has been most fully assessed. The IEA estimates, based on modelling, that global clean energy investments need to

7 https://doi.org/10.1007/s00550-024-00530-4

8 https://www.irena.org/news/pressreleases/2022/Jul/Renewable-Power-Remains-Cost-Competitive-amid-Fossil-Fuel-Crisis

9 https://www.ucl.ac.uk/news/2021/feb/fossil-fuel-air-pollution-responsible-1-5-deaths-worldwide

10 https://www.wri.org/research/green-jobs-advantage-how-climate-friendly-investments-are-better-job-creators

11 https://resourcegovernance.org/sites/default/files/RWI_Economic_Diversification.pdf

12 https://climatepromise.undp.org/news-and-stories/what-just-transition-and-why-it-important

increase to USD 4.5 trillion per year by 2030.[13] Over USD 1 trillion per year needs to be directed at emerging and developing economies (EMDEs) (excluding China). This would be an increase in energy investment from the present USD 3 trillion per year, of which 2 trillion is in clean energy, 300 billion of it in EMDEs excluding China.[14]

These top-down modelling estimates need to be complemented by bottom-up, in-country needs assessments.[15] The ultimate cost of the transition depends not only on techno-economic variables like the cost of electricity generation of different technologies, but also on the specific technology/infrastructure choices and policy instruments used by each government.

For instance, countries might choose to install their renewable energy sector in certain locations based on factors like the social acceptance of these technologies, the protection of certain landscape and ecosystem values, the institutional capacities of the regional authorities, among others. Similarly, governments can choose to incentivise the adoption of renewable energy with feed-in-tariffs or other types of public incentives, to increase the speed of adoption and social acceptance. Those choices can have considerable impacts in the cost estimates, and cannot be captured by global top-down estimates, although common policy priorities for developed and developing countries are well-known and reflected in some global assessments.[16]

Bottom-up estimates are important not only to get a more accurate picture of costs. These estimates serve as an investment prospectus, a tool for budgetary planning, and a basis for countries to negotiate finance, and should therefore be an integral part of the NCGQ negotiations and the NDCs 3.0.

National energy system models can be one of the most useful tools to estimate the costs of different scenarios.[17] However many countries, especially developing countries, still have not created such models and rely on consultancy firms or other external organisations to create the scenarios that inform their NDCs.

In contrast, countries like South Africa[18] and Indonesia[19] have been able to provide very detailed investment plans associated with their Energy Transition Roadmaps, making use of their own national energy and economy system models, as well as detailed project databases detailing the real cost of planned projects.

A global compilation of needs assessments has been published by the UNFCCC Standing Committee on Finance, which combines the needs stated by developing

[13] https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach

[14] https://www.iea.org/reports/world-energy-investment-2024

[15] https://www.irena.org/Energy-Transition/Country-engagement/RRA

[16] https://www.iea.org/reports/cop28-tripling-renewable-capacity-pledge/executive-summary

[17] https://doi.org/10.1016/j.rser.2020.109915

[18] https://www.climatecommission.org.za/south-africas-jet-ip

[19] https://jetp-id.org/cipp

countries in their submissions to the UNFCCC.[20] It cites a total cost of USD 5.0 to 6.9 trillion by 2030 for the achievement of countries' Nationally Determined Contributions, with 79% of costed needs related to climate change mitigation measures, and 60% of these for energy.

However, this is an underestimate for two reasons. First, not all countries provided cost estimates of their NDCs and of the ones that did, fewer than half of the measures within them were costed. Second, NDCs together fall well short of the ambition needed to achieve the Paris goals.[21] Several of the measures included by countries in the mitigation cost estimates are not compatible with a transition away from fossil fuels, including development of natural gas, carbon capture and storage, and efficient use of coal.

Economic transformation

If bottom-up assessments are important for assessing clean energy investment needs, they are even more so for assessing investments in alternative economic sectors. Whereas most countries' decarbonised energy systems will largely involve the same components, countries' economic strategies are all different, depending on their circumstances and opportunities. So before we can start to estimate the size of needed investments, we need to know what sectors are being invested in.

Part of the answer is clean energy. If used right, through national strategies, renewables can underpin and enable wider economic development, and indeed create a more diverse, inclusive, and resilient economy. But clean energy is unlikely to be the whole answer, especially for oil- and gas-exporting countries. No single sector is likely to simply substitute for oil, as no sector (other than some types of finance) can deliver rents, and hence government revenues, on the scale of oil. Instead, governments need to substantially diversify the structure of their economies. One key lesson is that diversification will not happen by itself: it requires deliberate industrial strategy[22] on the part of governments (see box). Governments can also create the enabling environment[23] to allow new sectors to thrive.

A key challenge for efforts to move economies away from dependence on fossil fuel extraction is that only a few countries have succeeded in doing so (see box), despite it being a stated policy priority of many countries since at least the 1970s.[24] During this period, there have been plenty of plans, many of them undelivered. Perhaps one reason is that the plans have tended to remain in the technocratic space of government elites and their consultants. As such, they have had neither the buy-in of the wider population, nor political champions to keep pressing them forward when

[20] https://unfccc.int/sites/default/files/resource/UNFCCC_NDR2_Report_Web_Final.pdf

[21] https://www.unep.org/resources/emissions-gap-report

[22] https://doi.org/10.1017/9781009339414

[23] https://resourcegovernance.org/sites/default/files/documents/precept_10_0.pdf

[24] https://doi.org/10.1016/j.resourpol.2017.02.007

governments lose interest, when vested interests resist the changes, or when governments undermine the plans through ongoing fiscal support to the fossil fuel sector.

An important newer approach seeks to build publicly-owned visions of the post-oil economy. For example, the Natural Resource Governance Institute has built a coalition of civil society in Colombia to develop a consensus narrative on the post-oil economy, based on respect for nature, sustainable use of resources, and empowerment of women, youth and Indigenous peoples.[25] Environment Rights Action and the Nigerian Labour Congress conducted a survey of the Niger Delta to assess communities' views on the future economy, which centres on the value of agriculture as a creator of jobs and a connection with cultural heritage.[26] In both cases, the vision is of a sustainable economy that benefits the broader society, in contrast to the unevenly shared benefits and costs of oil and gas extraction.

Ultimately, what is needed is a combination of the democratic and the technical: broadly-owned visions, rooted in expert assessment of viability and cost, and reinforced by public financial policies that favour an economic transition over ongoing reliance on fossil fuels. Until those processes have taken place, the best we can do is heuristic estimates. As a very first approximation, we can assume that investments in alternative sectors need to be at least of the same order of magnitude as expected investments in fossil fuel extraction, in order to have equivalent economic impact. While renewable energy has already surpassed fossil fuel investment, considerable amounts of investment is still going into the expansion of fossil fuel production. In 2023, the oil and gas industry invested USD 538 billion in exploration and production, of which USD 255 billion was in emerging and developing economies.[27]

However, since new economic sectors and industries included in the transition strategies will not have a 100% success rate, and since as noted above, oil and gas cannot be simply substituted by a single sector, it is reasonable to expect that a larger amount of investment in new industries will be required, and also the development of institutional capacities and human skills to deal with them. By comparison with the fossil fuel sector, we can infer that the investment need will be several hundred billion USD.

[25] https://resourcegovernance.org/articles/narratives-just-energy-transition-colombia

[26] https://www.ituc-csi.org/IMG/pdf/210429_-_just_transition_in_nigeria.pdf

[27] https://www.iea.org/reports/world-energy-investment-2024

Textbox 1: Examples of economic diversification

Few countries have succeeded in reducing their dependence on oil and gas. However, the success stories can be instructive in understanding what is needed. Among the successes, the Emirate of Dubai reduced oil's share of GDP from over 50% to less than 1% (whereas neighbouring emirate Abu Dhabi remains oil-dependent).[a] Dubai achieved this through a concerted strategy building on its geographical location and merchant culture, to become an import-export hub.[b] It later expanded into high-value industries, including property, tourism and finance. Similarly, Oman has been pursuing economic diversification efforts, which have resulted in an average yearly growth of 15% of non-oil exports since 2018.[c]

Former OPEC member Indonesia responded to the 1985 oil price crash by rapidly expanding its exports of labour-intensive manufactures.[d] The strategy was based on moves to integrate the South East Asian regional economy, a shift of manufacturing out of the Global North, and Indonesia's young and dynamic workforce. The government both created enabling conditions for export growth, and made strategic investments in education, infrastructure and new industries. Combined with decreasing production, the result was that oil rents' share of GDP fell from 30% in 1980 to less than 1% in 2015.[e]

a: https://aleklett.wordpress.com/2014/10/31/dubai-as-oil-producer/

b: http://dx.doi.org/10.1007/978-981-10-5786-1_5

c: https://www.tradefinanceglobal.com/posts/omans-economic-diversification-a-closer-look-at-non-oil-exports-and-trade-partnerships-in-2022/

d: https://www.iisd.org/system/files/publications/beyond-fossil-fuels-indonesia-fiscal-transition.pdf

e: https://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS?locations=ID

Funding a just transition

Even once we know what is needed to build a post-carbon energy system and economy, there are additional costs in getting there, such as in enabling a just transition, which protects the rights of workers and communities that depend on fossil fuels. While the transition to clean energy will create greater numbers of jobs than fossil fuels,[28] they are not always located in the same places, or requiring the same skills. Fossil fuel jobs are also among the best-paid jobs available; it will be important to ensure new jobs are of comparable quality. Definitions of just transition commonly include investments in alternative, job-creating sectors, as recommended by the International Labour Organization.[29] Since we have addressed those in the previous sections of this article, we now focus just on the transitional costs.

The UNFCCC published a report in 2023 synthesising the information on just transition from countries' long-term, low-emission development strategies (LT-

[28] https://www.wri.org/research/green-jobs-advantage-how-climate-friendly-investments-are-better-job-creators

[29] https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_emp/@emp_ent/documents/publication/wcms_886544.pdf

LEDS) and NDCs.[30] This review found that 57% of LT-LEDS describe commitments to just transition, but only 26% include a dedicated chapter with further details and only 9% provide “comprehensive details” on strategies for achieving elements of just transition.

- Over many years, countries undergoing coal transitions like Germany, the UK and in Poland, spent billions on just transitions.[31] It is unlikely that this scale of support can be replicated in emerging and developing economies without external assistance, given their constrained fiscal resources. While there are no global estimates provided for the cost of JT measures, a review by Maryland University of the historic case studies of Poland, Spain, the United States, Canada, the United Kingdom, Australia, and Germany estimates that the average cost per workers amount to USD $23,000 for rehiring support, USD $25,000 for income compensation, and USD $13,000 for health support policies.[32]
- Another review by iForest, based on the case studies of South Africa, Germany and Poland, estimates labour support costs of USD 6,200 to USD 22,000 per worker, plus a community resilience cost of USD 366 to USD 461 per affected community member (about 20% of JT investment plans).[33]

These reviews apply a hybrid approach, using bottom-up national and regional plans, to generate per-worker or per-person ratios that can be used in a more top-down way. According to the IEA, there are 18 million workers in fossil fuel extraction worldwide, and 3 million in fossil power generation.[34] Using the Maryland combined cost of USD 61,000 per worker, this would imply a total cost for these 21 million workers’ transitions of USD 1.3 trillion over the course of the transition (hence, if the transition took 25 years, this would imply USD 51 billion per year).

Only in a few cases do bottom-up estimates exist, such as the South Africa JETP investment plan,[35] the Comprehensive Investment and Policy Plan (CIPP) for Indonesia’s JETP,[36] and the European Union Just Transition Mechanism, which aims to provide €55 billion of targeted support from 2021– 2027 for just transition measures in Europe's most transition-vulnerable regions.[37]

While these estimates are instructive, again there is a danger of reducing the problem simply to a function of the number of jobs affected. In reality, communities in fossil fuel-producing regions rely on the fossil economy in numerous and complex ways, including wider economic contribution, local revenues and even culture and identity. Also, transition plans often do not account for the impact on informal workers and other traditionally disadvantaged groups.

In addition to supporting workers and communities, transitional costs sometimes

30 https://unfccc.int/documents/632339

31 https://doi.org/10.1038/s41467-024-47667-w

32 https://cgs.umd.edu/sites/default/files/2023-05/policybrief_GlobalJustTransition_5.25.pdf

33 https://iforest.global/wp-content/uploads/2023/03/Just-Transition-Costs-and-Cost-Factors.pdf

34 https://iea.blob.core.windows.net/assets/ba1eab3e-8e4c-490c-9983-80601fa9d736/World_Energy_Employment_2023.pdf

35 https://www.climatecommission.org.za/south-africas-jet-ip

36 https://jetp-id.org/storage/official-jetp-cipp-2023-vshare_f_en-1700532655.pdf

37 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en

include cleanup of environmental damage caused by fossil fuels.. For example, an official report commissioned by Bayelsa State, one of the four main oil-producing states in Nigeria's Niger Delta, finds that USD 12 billion would be needed over twelve years to clean up oil pollution.[38] The iForest study above estimates reclamation and repurposing of coal mines to cost USD $17.2 million to USD $28.2 million per million tons per annum.[39]

The polluter pays principle would imply that companies should clean up their own pollution. An optimal approach would be that governments' regulatory functions are sufficiently strong to enforce environmental laws - achieving this may require capacity-building, national reforms to extraction regulations, and/or international agreement on pollution control. However, some degree of public spending for restoration and cleanups will be needed where prior regulations were insufficient. Here, the government can integrate the restoration and clean-up activities with other transitional measures, to make this expenditure more aligned with objectives such as employment creation.

Textbox 2: Stranded fossil fuel assets

We have considered the investments needed to build the new energy system and alternative economic sectors, and the transitional costs in getting there. What about the loss of existing assets in the fossil fuel system? For example, a paper by Gregor Semieniuk and colleagues estimates that future lost profits in the upstream oil and gas sector exceed US$1 trillion, due to reduced demand for oil and gas resulting from net zero policies in Europe and Asia.[a]

As with environmental cleanup, the polluter pays principle provides the moral dimension of the answer. In this case, it would imply that companies involved in harmful activities should carry the economic cost of ending those activities, and do not deserve public support. Since the impacts of climate change have been well known for at least 30 years, most of the investment decisions were made being aware of the harmful impacts of the activity, which calls into question the moral basis of compensation. However, many governments prioritise paying such compensation, for pragmatic, political or legal reasons.

Often such compensation is required under international investment law. A study by Kyla Tienhaara and colleagues finds that phasing out oil and gas production in line with the IEA's Net Zero Emissions scenario could lead to legal claims of more than USD 340 billion.[b] The best solution here is reform of investment law, such as through withdrawal of consent for investment arbitration,[c] or a carveout of climate policy from the right to investment arbitrations.[d] Again echoing environmental cleanup, this is a case where institutional reform is needed.

To the extent these preferred solution; but where its cannot be achieved, these costs too will need to be covered, and for poor countries will likely need international financial and technical support. What these two cases illustrate is that some aspects of the cost of phaseout may be better met through institutional reform, technical support, and capacity building - nationally and internationally - rather than only cash transfers.

[38] https://report.bayelsacommission.org/

[39] https://iforest.global/wp-content/uploads/2023/03/Just-Transition-Costs-and-Cost-Factors.pdf

There is however an additional complication. Many of the fossil fuel assets that will be stranded are publicly owned, by state-owned enterprises. Whereas private investors arouse little sympathy for losses from their bad investments that sought and failed to achieve a profit, the situation is different where the investments were made for the sake of public provision of energy or generation of public revenues, and where any losses are at the expense of public budgets. In these cases, which should be examined on a case by base basis, external finance for investments in clean energy and economic transformation could need to be on concessional terms, to be viable compared to continuing with existing fossil assets (see section 'Meeting the costs').

a: https://doi.org/10.1126/science.abo4637

b: https://doi.org/10.1126/science.abo4637

c: https://www.iisd.org/itn/en/2018/04/24/withdrawal-of-consent-to-investor-state-arbitration-and-termination-of-investment-treaties-lise-johnson-jesse-coleman-brooke-guven/

d: https://doi.org/10.1093/jiel/jgad011

Meeting the costs: Sources of finance

From the initial estimates outlined above, the combined cost of clean energy investments is in the trillions, of economic transition in the hundreds of billions, and of just transition in the tens of billions of USD per year (not including cleanup or company compensation). Top-down estimates for developing and emerging economies' (excluding China's) share of clean energy investment alone is around USD 1 trillion per year; the total cost is thus likely somewhere between USD 1.5 and 2 trillion per year.

While these costs are large, it is important also to put them in context. For example, public support for fossil fuels totaled USD 1.7 trillion worldwide in 2022.[40] The US 2024 military budget was over USD 900 billion.[41] And investing in energy transition is cheaper than choosing not to act: a study by Maximilian Kotz and colleagues projects global climate damages of USD 38 trillion per year by 2049, escalating significantly thereafter if emissions are not restrained.[42]

In wealthy economies of the Global North, paying for a fossil fuel phaseout is complex but achievable. In poorer countries, there will clearly be a need for external finance to supplement more limited domestic resources. Only a small number of countries, like the Gulf monarchies, have grown wealthy from fossil fuel extraction; in other countries, fossil fuel revenues underpin large shares of public budgets, especially in countries with large populations. These countries can start to build up alternative sources of revenue, and indeed can redirect current spending from fossil

40 https://www.energypolicytracker.org/burning-billions-record-fossil-fuels-support-2022/

41 https://www.usaspending.gov/agency/department-of-defense?fy=2024

42 https://doi.org/10.1038/s41586-024-07219-0

fuels; however much of the cost will need to be met by international finance.

What form should this external finance take? Supporting workers and communities through a just transition creates a societal benefit and helps enable transition, but does not directly generate returns and so requires grants rather than loans, to address the uneven local impacts on jobs and regional development. If cleanups and compensation cannot be addressed according to the Polluter Pays Principle, through capacity building and institutional reform, these costs too will need to be met by grants, for the same reason.

Since the investments in the new energy system and economy will generate returns, this opens the possibility of other forms of finance, such as loans. However, it would be wrong to infer that all this finance can simply be provided commercially by the private sector, for several reasons. First, while renewable energy is cheaper than fossil fuels in most of the world, the exception is in many poorer countries, due to the high cost of capital. Second, the private sector tends to be less interested in crucial investments in transmission infrastructure, as opposed to generation. Third, a rapid energy transition requires renewables to replace fossils faster than normal capital replacement as driven by markets. And fourth, many countries already have unsustainable external debts, and cannot be expected to deepen these for the sake of a global transition. For example, a study by the International Institute for Environment and Development finds that low-income countries spend more than 10% of their budgets on debt servicing.[43]

Grant-based and concessional finance will therefore be crucial. This remains a major gap in international financial flows, despite agreement in both the Paris Agreement[44] and the UN Framework Convention on Climate Change[45] that developed countries shall provide finance to developing countries. For example, of the funds provided to South Africa's JETP only 4% consist of grants, although big amounts of concessional loans are also included.[46] There is considerable potential to increase public financial flows to clean sectors. For instance, members of the Clean Energy Transition Partnership have reduced their international public finance for fossil fuels substantially, but have not scaled up clean energy finance at the same scale.[47]

In addition, institutional reform and structural change are needed. One reason many developing countries need external support is that unfair terms of trade,[48] and the international tax, investment and debt systems cause a net outflow of money from poor to rich countries.[49] This has a major impact on fiscal space for investing in

[43] https://www.iied.org/low-income-countries-using-over-10-budgets-service-debts

[44] https://unfccc.int/sites/default/files/english_paris_agreement.pdf

[45] https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

[46] https://www.wits.ac.za/news/latest-news/research-news/2024/2024-03/what-happened-to-the-just-energy-transition-grant-funding.html

[47] https://www.iisd.org/publications/report/countries-underdelivering-fossil-clean-energy-finance-pledge

[48] https://doi.org/10.1016/j.gloenvcha.2022.102467

[49] https://justtransitionafrica.org/

energy transition. Reform of these systems could reduce the needs for external finance.

In this article we have proposed a framework for assessing the costs of a fossil fuel phaseout. But we conclude with a reminder that the problem cannot be solved simply with a particular amount of money. As the foregoing discussion shows, there will also be a need to build institutional and human capacities, to manage both the new system and also the process of getting there.

Annex 1 - Overview of transition costs discussed in the article

Type of cost	Comments
1. Fossil fuels phaseout from domestic energy sector	All countries require this transition, and benefits will outweigh the costs in the long term for most countries.
- *Clean energy investments*	This includes building renewable energy, heat pumps and insulation in buildings, improving power grids, and electrifying transport. Bottom-up estimates are needed since they are highly dependent on policy choices and other factors such as resources endowments, geography, etc..
- *Institutional reforms for the operation of a RE based system*	This includes costs of building the institutions and skills to manage a system based on renewable energy. Direct Technology transfer and capacity building are needed in addition to monetary transfers.
- *Debt cost for non-concessional loans*	Depends on share of concessional finance and interest rates for remaining finance, as well as from the specific ownership and financing arrangements.
- *(negative cost) Savings in FF subsidies, FF imports, and other FF sector cost (e.g health and env. costs)*	These negative costs (or benefits) are difficult to estimate but all existing estimations (e.g. health co-benefits)point to them being quite significant.
2. Fossil fuels phaseout from national and subnational economies	Only relevant for fossil fuel-dependent producers and exporters. Also economically beneficial over the long term for most countries.
- *Investments in new economic sectors development*	Bottom-up estimates are needed since they are highly dependent on choices of economic direction and other national factors such as resource endowments, geography, etc. Redirecting national investments in the fossil fuel sector (e.g. subsidies) is a priority and concessional finance should be prioritised.
- *Institutional reforms for the management of economic diversification / transformation efforts*	This includes the costs of building the institutions and skills to manage the transformation of the economy and the new economic sectors. Direct Technology transfer and capacity building are needed in addition to monetary transfers.

- *Debt cost for non-concessional public investment*	Depends on share of concessional finance and interest rates for remaining finance, as well as from the specific ownership and financing arrangements.
- *(negative cost) Savings in FF production subsidies and investments in FF exploration and greenfield development.*	These negative costs (or benefits) are difficult to estimate, but all existing estimations (e.g. of co-benefits of fossil fuels subsidy removals) point to them being quite significant.
3. Fossil fuels phaseout just transition cost	Needed to ensure social acceptance of the transition and avoid high socio-economic impacts.
- *Transitional cost for reskilling, etc of affected actors*	Bottom-up estimates are needed since it depends on the scale of the fossil fuels sector, its characteristics, economic contribution, as well as policy choices on the new sectors to which the transition aims.
- *One-time compensation to affected actors*	Highly country-specific. It depends on the structure and power dynamics of the fossil fuels sector in the country and its extracting regions. If the polluter-pays principle is applied, fossil fuel companies should not be compensated.
- *Costs of management of environmental and social (e.g. health) legacy of fossil fuels*	Since fossil fuel reserves are limited, this is a cost that would need to occur regardless of the transition. However, with an accelerated FFPO, the cost of bringing up this cost earlier can be considered a transitional cost. If the polluter-pays principle is applied, fossil fuel companies should be responsible for covering the legacy costs of extraction.
- *Planning and governance*	Direct Technology transfer and capacity building are needed in addition to monetary transfers