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How are climate policies assessed in emerging economies? A study of ex-ante policy appraisal in Brazil, China, and India

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ABSTRACT

Effective mitigation of climate change requires a robust set of policy interventions. Existing policy appraisal frameworks and approaches impact the design and choice of these policy options. However, their application to transformative climate policy can present several shortcomings. In light of criticism around current appraisal methods, we review the climate policy appraisal landscape and interview policy experts in three major emerging economies: Brazil, China and India. Little research has been done on the perception, approach, and practice of policy appraisal in these countries, even though they will have a significant impact on global progress to mitigate climate change. We find that policy appraisal in Brazil, China, and India is supported by guidelines, but the detail and implementation of those guidelines vary significantly. Cost–benefit analysis (CBA) is the prevailing decision-making framework in both Brazil and India whereas multi-criteria analysis is the dominant framework in China. Practitioners appear to understand CBA and its limitations well but also value its usability and the perception of robustness. Across all countries, political considerations can outweigh appraisal findings; respondents suggested this can be negative, in the sense that appraisal results are sometimes ignored, but can also be positive in the sense that other objectives are considered. Existing approaches present several limitations, particularly regarding transformational change, which could hamper progress to formulate and implement effective climate and energy policy.

Key policy insights:

- Guidelines that standardize the appraisal process are considered better for accountability and therefore increase the influence of appraisal in policymaking.
- The choice of approach affects the appraisal outcome. The type of policy and its intended aims should inform the method of appraisal used.
- Climate policies are often transformational in nature. As such, their outcomes can be very uncertain. More efforts are needed to integrate these considerations of uncertainty into appraisal frameworks.

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- More computational models that consider system feedbacks and uncertainty are needed to robustly analyse the impacts of transformative policies.

1. Introduction

Effective climate change mitigation will require stringent policies and close coordination across the public and private sectors (IPCC, 2022). The policy choices of governments will not just impact the speed and scale of decarbonization but also various socio-economic outcomes, including health impacts and employment opportunities (Karlsson et al., 2020; Spencer et al., 2018). Designing and implementing effective policy packages is contingent on having the appropriate methods to perform an ex-ante appraisal of the impact of these policies (Mercure et al., 2021). The application of those methods and approaches will depend on the institutions and rules of a specific country. This paper aims to shed light on how climate and energy policy appraisal processes are currently operated in Brazil, China, and India, to support transformational policy design and the low carbon transition in these economies.

We interpret appraisal to refer to analysis done before the implementation of plans, policies, and projects (ex-ante analysis). Therefore, when we talk about policy appraisal, we do not consider analysis after the implementation (ex-post analysis). This is in line with both the European Commission's definition (Smismans, 2015) and the usage of the term in the UK's Green Book (HM Treasury, 2020), which is considered world-leading guidance on how to appraise policy (Mercure et al., 2021; Turnpenny et al., 2014). For many countries, ex-ante policy appraisal is an important part of the policy cycle, bringing evidence and rigour to the policy process (Turnpenny et al., 2009). This includes finding the most effective use of the resources available under a given set of objectives and constraints (HM Treasury, 2020). While the focus of appraisal was initially purely financial – ensuring the effective use of capital to maximize utility – modern policy appraisal systems have evolved to consider a range of criteria beyond finance (Mickwitz, 2003).

Understanding how policy appraisal is perceived and conducted by policy analysts is key to developing a better understanding of the role evidence plays in policy formulation and decision-making. This can enable improvements in policy outcomes more broadly, particularly concerning policies where the aim is transformational change, as is frequently the case with climate policies (Mercure et al., 2021). The outcome of policy appraisal is influenced by the framework(s) and method(s) used. Cost–benefit analysis (CBA), which quantifies the 'gains' and 'losses' in monetary terms and compares these, is the prevailing appraisal method, at least in the Global North (Livermore & Revesz, 2013; OECD, 2018). However, despite the widespread application of CBA, the framework faces several shortcomings including an intrinsic status quo bias and inadequate treatment of uncertainty and distributional issues. These shortcomings could limit the effectiveness of CBA when applied to transformative policy and could therefore have a detrimental impact on the formulation of successful climate policy.

In the literature, there has been a greater focus on determining how appraisal (and CBA in particular) *should* be carried out rather than *how* it is used in practice (Howlett et al., 2014; Livermore & Revesz, 2013). Nevertheless, several comparisons of appraisal methods exist, albeit almost exclusively in OECD countries (Nilsson et al., 2008; OECD, 2018; Turnpenny et al., 2015). Across these countries, despite the differences in administrative culture, institutional context, and procedural design, CBA is the main method used in ex-ante policy appraisal and its application is found to be broadly consistent (Hertin et al., 2009; OECD, 2018). However, there is little research on the perception, approach, and practice of policy appraisal in emerging economies.

In this study, we aim to address these knowledge gaps, reviewing how policy appraisal is conducted to support transformational change outside of the OECD, focusing on Brazil, China, and India. These countries are key emerging economies, and their climate and energy policy development will be influential in global climate change mitigation efforts. We use literature reviews and interviews with climate policy experts to both understand the appraisal landscape in each country and consider the experiences and perceptions of practitioners. The paper is structured as follows: section 2 describes the two most prominent appraisal methods, the history of their application, and their suitability for analysing climate and

transformative policies. Section 3 outlines the methodological approach of the study. Section 4 describes the key results of the literature and document reviews, and the expert interviews. Section 5 analyses the appraisal landscape in each country with specific reference to climate and energy policy and section 6 concludes.

2. Cost–benefit analysis and multi-criteria analysis – an overview

CBA has emerged as the prevailing method for policy appraisal in the Global North (Livermore & Revesz, 2013; OECD, 2018). It aims to quantify the costs and benefits of a proposed policy or project in monetary terms and provides a robust framework for analysing and comparing policies with marginal impacts, especially where costs and benefits can be monetized straightforwardly (Mercure et al., 2021). CBA is based on welfare economics, and the Kaldor-Hicks compensation principle in particular, where the 'optimal' solution maximizes societal welfare in aggregate terms (Marleau Donais et al., 2019). By viewing societal welfare as a whole, it is assumed that 'winners' can compensate 'losers' for their welfare loss (Munda, 2017).

Multi-criteria analysis (MCA) is another common method for policy appraisal, particularly in the European Union (European Commission, 2015; Turnpenny et al., 2015). Unlike CBA, MCA does not require the quantification of all costs and benefits and offers greater flexibility to include multiple or conflicting objectives, and criteria with broader social and environmental impacts (Dean, 2020; Mouter et al., 2020; Munda, 2017). MCA is used as a catch-all term for many different tools including analytical hierarchy process, weighted sum, and ELECTRE methods (Kabir et al., 2014). CBA can be one criterion in an MCA (Mouter et al., 2020) and both methods can and frequently are used alongside other tools and approaches, including but not limited to computable general equilibrium and simulation-based models (Nilsson et al., 2008) and co-benefits analysis (Ürge-Vorsatz et al., 2014; Cohen et al., 2017). MCA is often used more in a supplementary role, especially when significant uncertainties exist (Pohekar & Ramachandran, 2004; Sahabuddin & Khan, 2021).

CBA has been a central decision-making framework in the US since 1981, following the issue of Executive Order 12291, mandating the use of this method for the appraisal of all major policies. The UK followed suit, with the integration of CBA into government later that decade (Pearce, 1998). The European Commission formed its impact assessment system in 2002, in which CBA has an important role alongside MCA (European Commission, 2012; 2015).

In addition to the formulation of individual climate policies, CBA has also been an important framework in setting the global agenda for climate policy. For over 30 years, CBA has been widely used in integrated assessment models (IAMs) (Weyant, 2017). These include DICE, FUND, and PAGE, three models used by the US Government in their calculation of the Social Cost of Carbon (SCC) (Carleton & Greenstone, 2021; Interagency Working Group on Social Cost of Greenhouse Gases, 2016). Whilst the SCC has seen limited application in policy appraisal outside of the US, it has had a sizable impact in informing the global climate policy narrative for many decades (IPCC, 2018).

Despite the widespread application of CBA in this domain, the framework faces several shortcomings that could limit its effectiveness and hence the formulation of successful climate policy. First, the inadequate treatment of the distribution of costs and benefits is a long-standing critique of CBA (Talvitie, 2018). Although more modern approaches can use weighted costs and benefits to better reflect the relative impacts of a policy (Livermore & Revesz, 2013), such considerations are rarely applied (OECD, 2018). Furthermore, CBA faces criticism regarding its treatment of uncertainty. This is a particularly key limitation for climate change since the CBA output is commonly reported as a single number without any stated uncertainty, which impedes the consideration of extreme climate scenarios and the reliable measurement of climate change impacts (Ekholm, 2018; Pindyck, 2013; van den Bergh & Botzen, 2015). CBA is also unable to handle probability distributions with heavy tails (Weitzman, 2009).

Additionally, CBA possesses an intrinsic status-quo bias, since the costs of a policy to a pre-existing known economic context are, almost by definition, more certain than the potential benefits of a hypothetical policy outcome (Mercure et al., 2021). Furthermore, applications of CBA often do not consider the potential co-benefits of proposals (Karlsson et al., 2020). Therefore, using CBA to appraise policies where the expectation or the desired outcome is transformational change could be severely flawed.

3. Methods

3.1. Study design

We adopt a multi-pronged approach using a literature and document review, along with semi-structured interviews. This approach allows us to collect data on both the presence of appraisal guidelines and supporting material, as well as the perceptions and experiences of policy experts and practitioners. We used the data collected in the literature and document review to shape the structure and focus of the interviews, targeting areas in the literature where some significant gaps or themes appear noteworthy.

3.2. Literature and document review

The first stage in our approach was to identify existing studies on policy appraisal, first in Brazil, China, and India, and in emerging economies more generally. We used Google Scholar with the following combination of search terms: 'policy' or 'project' and 'appraisal' or 'evaluation' or 'assessment' and 'Brazil' or 'China' or 'India' or 'Global South' or 'emerging economy'. Our initial scoping of the literature focused exclusively on studies relating to climate and energy policy, but this yielded very few results, leading us to broaden the search terms. We also subsequently widened this search to include studies from the Global North.

Overall, the policy appraisal literature is almost exclusively focused on OECD regions and is therefore of limited interest here (e.g. Nilsson et al., 2008; OECD, 2018; Turnpenny et al., 2015). Literature specifically focused on CBA in the Global South or emerging economies is more abundant but could nevertheless be broadly categorized into: i) studies that discuss how CBA should or could be tailored to meet the needs of developing countries (e.g. Kirkpatrick & Weiss, 1996; Little & Mirrlees, 1974; Nas, 2016; van Pelt, 1993); or ii) studies that focus on ex-post evaluations of policies, or theoretical applications of CBA and other methods, as opposed to their ex-ante application (e.g. Chowdhury et al., 2018; da Silva et al., 2012; Livermore & Revesz, 2013). We provide more detail on this literature in Supplementary Material Section 1.

The second stage of our review involved the collection of relevant documents that served as guidelines for appraisal. Given the nature of these documents, literature databases like Google Scholar were not appropriate here. Instead, we performed document searches on relevant government websites for appraisal guidelines or other appropriate material related to the assessment of climate policy. This included the websites of the Government of Brazil, the NITI Aayog (the policy think tank of the Government of India), and the National Development and Reform Commission in China (NDRC). We include the full list of websites searched in Table S1 (Supplementary Material). Where necessary, key documents were summarized and translated into English. We also asked policy experts in each country to identify documents they thought were relevant to our aims. We summarize the documents found in our review in Table 1.

3.3. Interviews

Respondents were identified through the Communities of Practice of the Economics of Energy Innovation and System Transition project[1] based on their seniority level, policy expertise, and engagement with the climate-energy debate (see Section 2.1.1 Supplementary Material for more detail on respondent selection). In total, 42 prospective respondents were selected from across the three countries (16 in Brazil, 10 in China, and 16 in India) from a range of different backgrounds. These included academics, government policymakers and analysts, and private sector analysts from the power, transport, infrastructure, and environmental policy areas. In total, 23 interviews were conducted (see Table 2 for a breakdown of respondent characteristics) with response rates of 50% in Brazil, 60% in China, and 56% in India. It is worth noting that the interviews took place at a time when all three countries, but particularly India, were struggling with COVID-19 outbreaks.

While we acknowledge the number of respondents is small relative to the size and diversity of these countries, it is not our aim to offer an exhaustive analysis of appraisal but rather to provide a sample of

[1] https://eeist.co.uk/about

Table 1. An overview of the key documents relating to policy appraisal found in each country.

Country	Document	Description	Scale	Link
Brazil	Public policy evaluation: Practical guide to ex-ante analysis, volume 1 *(In Portuguese: Avaliação de políticas públicas: guia prático de análise ex ante, volume 1)*	Formal guidance for ex-ante policy evaluation.	National	https://www.gov.br/casacivil/pt-br/assuntos/downloads/153743_analise-ex-ante_web_novo.pdf/view
	Guide for the elaboration of Regulatory Impact Analysis – RIA *(In Portuguese: Guia para elaboração de análise de impacto regulatório – AIR)*	Provides an overview of six methods for regulatory impact assessment. This document does not detail how methods should be implemented.	National	https://www.gov.br/casacivil/pt-br/assuntos/governanca/regulacao/boas-praticas-regulatorias/consulta-publica/consulta-publica-001-2017-diretrizes-e-guia-air-pasta/encerramento/guia-air.pdf
	General Guide for Socioeconomic Cost-Benefit Analysis for Infrastructure Investment Projects *(In Portuguese: Guia Geral de Análise Socioeconômica de Custo-Benefício de Projetos de Investimento em Infraestrutura)*	Provides guidance on how CBA should be used to appraise infrastructure projects.	National	https://asmetro.org.br/portalsn/wp-content/uploads/2021/03/Guia-Geral-ACB.pdf
China	Interim Regulations of Major Administrative Decision-Making Procedures (*In Chinese:* 重大行政决策程序暂行条例*)*	Attempts to standardize the decision-making process, detailing the role of expert opinion and public consultation in the appraisal process. It does not prescribe any particular methods.	National	https://www.gov.cn/zhengce/content/2019-05/08/content_5389670.htm
	Regulation on Government Investment *(In Chinese:*政府投资条例*)*	Regulation on how the government should invest public funds cautiously and efficiently. Specifically, it requires a feasibility report and other documents before approval.	National	https://www.gov.cn/zhengce/content/2019-05/05/content_5388798.htm
	Rules of Public Participation in Major Policy Decision-making *(In Chinese:* 重大行政决策公众参与制度*)*	Guidance on how public hearings and consultations should be organised in the decision-making process. This is an example of how different provinces implement the national policy documents on policy appraisal.	Provincial	http://xjq.nc.gov.cn/xjqrmzf/xxgkzd1/202012/eb3d8b6b8c774e3db7026e47e53544b8.shtml
India	Revised Guidelines for Appraisal and Approval of Public Funded Schemes and Projects	Guidance on who appraisal should be carried out by and the structure of written appraisal reports. This stipulates that a CBA should be undertaken where returns are quantifiable.	National	http://164.100.94.129/efc/9May/AppraisalGuidelines05082016.pdf

views and themes from a carefully identified set of climate policy experts. We also acknowledge a limitation regarding the number of government analyst respondents relative to respondents from academia and other sectors. This is particularly the case in India, where most respondents were external to the appraisal process. Additionally, despite efforts to establish a common definition of key terms, there were occasional issues regarding the interpretation of terminology where respondents focused more on the policy-making process itself rather than appraisal.

Table 2. Respondent overview.

Country	Reference	Organization Type	Background Expertise	Seniority
Brazil	B1	Academic	Economics	Senior
	B2	Public Sector	Engineering	Junior
	B3	Public Sector	Economics	Middle
	B4	Academic	Economics	Middle
	B5	Academic	Economics	Senior
	B6	Non-government Organization	Economics	Senior
	B7	Public Sector	Engineering	Middle
	B8	Public Sector	Engineering	Junior
China	C1	Anonymous	Anonymous	N/A
	C2	Public Sector	Environmental Science	Senior
	C3	Academic	Social Science	Middle
	C4	Public Sector	Engineering	Middle
	C5	Academic	Engineering	Senior
	C6	Public Sector	Environmental Science	Senior
India	I1	Public Sector	Economics	Middle
	I2	Non-government Organization	Engineering	Senior
	I3	Non-government Organization	Economics	Middle
	I4	Public Sector	Economics	Middle
	I5	Academic	Economics	Senior
	I6	Public Sector	Social Science	Senior
	I7	Private Sector	Engineering	Senior
	I8	Public Sector	Social Science	Senior
	I9	Non-government Organization	Economics	Senior

Interviews were conducted by four researchers in three different languages (English, Mandarin, and Portuguese) between June and August 2021. In China, interviews were conducted in person while in Brazil and India, interviews were conducted by video call. The interview duration was between 30-45 min and focused on five sections informed by the literature and document review. The five sections were as follows: (1) general questions on policy appraisal, (2) appraisal methods, (3) the process of appraisal, (4) risk and uncertainty, and (5) the policy cycle (see Supplementary Material Section 4 for a full breakdown of interview questions). Before the start of the interview, respondents were provided with a document (Supplementary Material Section 3) containing definitions of terminology used in the interview questions. Further to this, at the start of the interview, respondents were asked how they interpreted the term '*policy appraisal*' to ensure that the respondent and interviewer had the same understanding of the term. This was determined as important during the literature review, since the terms '*appraisal*', '*assessment*', and '*evaluation*' were commonly used interchangeably, and the meanings could be different in different countries. Here, we interpreted appraisal to refer to before the event (ex-ante) policy analysis.

Thematic analysis was undertaken (Braun & Clarke, 2006), with data from the interviews analysed using the NVivo 12 qualitative data analysis software (Lumivero, 2017). We used qualitative data coding to derive themes and patterns from the interviews. Following a first round of coding by the core research team and informed by the literature and document review, an initial set of 40 codes was identified (Supplementary Material Table S2). Codes were consistent across all countries. An iterative coding process was then applied, with a supervisory researcher, regular coding meetings, and a final moderation stage ensuring intercoder reliability. Further detail on the methodological approach is provided in Supplementary Material Section 2.

4. Results

To understand the policy appraisal landscape in each country, we begin with a brief overview of the key institutions and policy context based on the literature and policy review. We then present results from the expert interviews and extract common and country-specific themes. An overview of important institutions for policy appraisal in each country is given in Figures S1-S3 (Supplementary Material). Key findings are summarized in Table 3.

Table 3. A summary of the key findings in each country, including the use of appraisal guidelines,who the key actors in policy appraisal are, and important climate and energy policies highlighted in the interviews.

	Key themes	Roles of CBA and MCA	Is formal guidance provided on policy appraisal?	Key actors in conducting appraisal	Key policies and policy processes
Brazil	• Big variation in the practice of appraisal between institutions • Fear of political reprisals leads to vague appraisals	CBA and MCA used	• Yes, there is a range of different guidance, including some which are relatively detailed (e.g. 'General Guidelines for CBA of Investment in Infrastructure Projects', 'Guide for the Elaboration of Regulatory Impact Assessment – RIA' and 'Public Policy Evaluation: Practical Guide to Ex-Ante Analysis').	• Ministry of Economy • Ministry of Mines and Energy • BNDES (Brazilian development bank) • Federal regulatory agencies • Energy Research Office (EPE)	• 2055 energy plan by the Ministry of Mines and Energy • Net-Zero scenarios, to be produced by the Energy Research Office • Creation of new policy appraisal guidelines • BNDES in green industrial policy
China	• Costs perceived as less relevant • Alignment with Five-Year Plan and other policy goals emphasized • Use of pilot programmes as an appraisal method	MCA is more influential than CBA	• Yes, guidelines exist at national and provincial levels but do not provide detailed guidance on how to conduct appraisal or which methods to use. • Respondents were not aware of such guidelines.	• National Development and Reform Committee (NDRC) • Ministry of Ecology and Environment (MEE) • Ministry of Finance • Ministry of Science and Technology • Research institutes and think tanks	• 'Greener' Five-Year Plan and sectoral sub-plans • '1 + N' carbon neutrality framework plans • New Emission Trading System launched in 2021
India	• The influence of political decisions in policymaking • The use of external consultants • Engagement and stakeholder events • Consideration of unquantifiable factors	CBA and MCA used	• Yes, appraisal guidelines are maintained by NITI Aayog and PAMD, but these do not provide detailed guidance on how to conduct appraisal or which methods to use. • Non-government respondents were not aware of such guidelines.	• NITI Aayog (Government policy think tank) • Project Appraisal and Management Division (PAMD) • Third-party Consultants	• Emergence of NITI Aayog, PAMD and DMEO as influential stakeholders in the appraisal process • National Hydrogen Mission • India's 2070 net-zero target

4.1. Brazil

The Brazilian appraisal system is based on federal regulatory agencies, which are responsible for inspecting and controlling policy as an impartial administrator that aligns private and public interests. Policy appraisal in Brazil is mainly performed by internal government agencies, with a strong focus on monetizing costs and benefits. According to the Brazilian legislation Law 13874, known as the 'Law of Economic Freedom', every regulatory proposal aiming to '*edit and amend normative acts of general interest to economic agents or users of services provided*' must be preceded by a regulatory impact assessment (RIA). Listed in Decree 10411, CBA is one of the six methodologies that can be used for RIA, along with methods such as multi-criteria analysis and risk analysis.

In 2018, the Federal Government published guidance for ex-ante policy evaluation, called 'Public Policy Evaluation: Practical Guide to Ex-Ante Analysis', which aims to provide analytic tools for public policy formulation (Casa Civil, 2018). Another recent example of building expertise within the government is the publication of the Brazilian cost–benefit guide, which focuses on large-scale infrastructure projects (SEPEC, 2021). This is influenced by the UK Green Book and aims to standardize the project appraisal methodology across the country. The recent efforts to update the policy appraisal system respond to the highly fragmented nature of decision-making processes in Brazil, with no single procedure for appraisal that is linked to longer-term policy objectives.

4.1.1. Use of CBA and MCA

Respondents highlighted several methods and tools currently used for policy appraisal, including 'productivity-impact analysis', 'technical viability studies', econometric methodologies, and computational general equilibrium models. However, respondents believed that the dominant method by far is CBA. CBA is used widely '*for important and relevant projects*' (B3) and its use will continue to spread since recent regulations have made policy appraisal mandatory for some federal institutions, such as the Ministry of Economy and the Ministry of Mines and Energy. Respondents suggested new guidelines for policy appraisal (Casa Civil, 2018), regulatory impact assessment (SEAE, 2021a), and infrastructure investment projects (SEPEC, 2021) will lead to wider adoption of CBA across the federal government. They also reported that MCA is often used alongside CBA. For example, when drafting the multiannual plan for 2020-2023, an '*exercise of prioritization of all projects from a multi-criteria analysis*' (B7) was carried out.

4.1.2. Shortcomings of appraisal methods

The respondents acknowledged that, while monetary costs are considered straightforward to estimate and include in the analysis, benefits are more difficult to estimate and therefore to include, especially when they are not monetary. An example given by one respondent was the '*light for all' ('luz para todos')* programme, which sought to extend electricity access to rural areas of Brazil to provide long-term economic and social benefits. In such a case, in a standard static CBA, the costs would be far greater than the economic benefits and factors that '*had relevance beyond the quantitative, monetary issue*' would be left out (B1). These benefits could include employment opportunities, democratizing electricity access, and increasing the overall quality of life for rural communities. The omission of these and other unquantifiable and non-monetary impacts is a major disadvantage of CBA.

The subjectivity of both CBA and MCA was also highlighted. For CBA, one respondent pointed out that monetizing impacts that are not '*market tradable*' (B8) is considered to be a significant issue and the estimation of these non-marketable values is subject to '*a certain degree of subjectivity*' (B8). For MCA, subjectivity was associated with the choice of weights assigned to each criterion, which can lead to the decision becoming '*susceptible to manipulation'* (B8). Another issue relates to the omission of risk and sensitivity analyses, especially for climate change scenarios.

4.1.3. Varied institutional capacity and limited transparency

Respondents described that the use of policy appraisal methods varies significantly across different departments in Brazil, often due to different skill sets and areas of expertise. Respondents believed energy and economic policy are mostly assessed by capable technical teams at their respective ministries. The Brazilian Bank for Social Economic Development (*BNDES – Banco Nacional de Desenvolvimento Econômico e Social*) is considered one of the institutions with the strongest capability to develop high-quality assessments of socio-economic policies, though these appraisals are not always made public. This lack of transparency is regarded as an issue, as one respondent remarked: '*The big problem is that the process is not public. They do [the appraisal] but don't tell you!*' (B5).

The interviewees also highlighted the lack of a '*well-established culture of evaluating public policies in a quantitative way*' (B3). The existing system is '*fragmented*' and '*compartmentalized*' (B3). The imbalanced capacity between departments and sectors will continue to hinder appraisal outcomes in Brazil. However, the

government is strengthening this by facilitating communication both within Brazil and internationally, through more conversations with international counterparts and training courses and workshops.

4.1.4. 'Pen blackout' and fear of deciding

Brazilian law stipulates that the proponents of policies are typically responsible for their appraisal. As a result, policymakers are held accountable if their policies fail to meet the standards set by the appraisal, and they may experience bureaucratic and legal retaliation. This could include loss of employment, the payment of significant fines, and even imprisonment (De Sordi et al., 2021). Policymakers can therefore be reluctant to do thorough appraisals and instead often decide to implement vague appraisal criteria to protect themselves from retaliation. This is known in Brazil as 'pen blackout' ('apagão das canetas'). One respondent describes a result of this being that appraisal '*gets heavily judicialized instead of focusing on the issue from an administrative point of view or whatever the criteria are*' (B6). They go on to suggest the legal uncertainty ends up '*slowing down the government*' (B6).

4.2. China

In China, the policy appraisal system is mostly integrated into the administrative decision-making and implementation agencies. The National Five-Year Plan are considered the most important policy document through which the central government in China sets the overarching environmental and energy goals (Karplus et al., 2021). The major responsibilities to achieve those goals falls on the following key ministries within the State Council: The NDRC, the newly integrated Ministry of Ecology and Environment (MEE), the Ministry of Finance, and the Ministry of Science and Technology.

The role of policy appraisal and evaluation is increasingly important in the Chinese government's efforts to modernize its governance system and capacity. The 14th Five-Year Plan, published in 2021, which requires the establishment and improvement of the systems of evaluation and supervision, is an important step in increasing the robustness of policymaking (Li, 2021; People's Government of Fujian Province, 2021). In 2019, the State Council issued the Interim Regulations of Major Administrative Decision-Making Procedures (Regulation). This seeks to standardize decision-making processes, strengthening public and expert consultation. The wider social impacts of decisions in areas such as employment, health and environment are encouraged to be embedded into macroeconomic governance systematically (Regulation, 2019, Article 12). In 2018, as part of institutional reform, the Department of Evaluation and Supervision was created within the NDRC, with responsibility for formulating, evaluating, and supervising major plans, policies, and projects; otherwise known as 'three majors'. For different ministries, there are specialized departments or bureaus, or affiliated research centres and think tanks dedicated to policy appraisal and evaluation. More than 95% are affiliated with the government (Ministry of Civil Affairs, 2017), which undermines their autonomy. To make the appraisal process more objective and robust, the Chinese government is developing and supporting more independent third-party policy think tanks (Ministry of Civil Affairs, 2017).

4.2.1. Use of CBA and MCA

While CBA is used, its application does not appear to be as key to the appraisal process as in many Western countries (Lei et al., 2008; Zhao, 2013). Significantly, respondents suggested that the direct application of CBA in policy appraisal is '*rare*' (C2). This could be because China does not necessarily prioritize economic concerns as much as Western countries when appraising policies. One respondent noted that '*cost is not the only factor for deciding whether to launch the policy or not, sometimes other factors can be more important, for instance, the feasibility of the policy*' (C2). Furthermore, '*the priority of CBA is not very high. There are more qualitative balances, rather than focusing on monetary measures*' (C3). The weight given to the consideration of efficiency and monetary terms is believed to be '*flexible on a case-by-case basis*' (C3). Meanwhile, the use of MCA is more common, and respondents recognized that MCA enables the consideration of multiple aspects, some of which are difficult to quantify. It was suggested that MCA can '*avoid*' certain government departments from pursuing self-interests, which can be '*narrow and limited*' (C1).

4.2.2. Non-monetisable factors

Several respondents highlighted that some social factors that are difficult to quantify can play a significant role in appraisal. Examples include health benefits, cultural impacts, and the effect of renewables on biodiversity. The contrast with many countries in the Global North, where economic considerations have a more central role in policy appraisal (Nilsson et al., 2008), was mentioned explicitly by some respondents. One emphasized that '*narrowly defined*' (C1) economic criteria are insufficient to incorporate different policy objectives from a longer-term view. Another respondent affirmed that '*a lot of policymaking cannot rely on the monetary factors only. Micro and monetary factors do not suffice for macro decision-making*' (C6). This view was echoed by another respondent who summarized that '*for the state, efficiency may not be the most important. It is a consideration between equality and maximizing national interests*' (C3).

Although acknowledging the basic function of quantitative analysis as a referencing point, some respondents showed scepticism toward quantitative methods and tools. One respondent noted that '*those analysis can be a good reference, but in policymaking, many aspects cannot be appraised quantitatively*' (C2). Another respondent highlighted that quantitative tools are helpful, but not decisive (C6). This view was strengthened by another respondent, remarking that '*I cannot emphasize more the importance of this point. The quantitative part sometimes can be very misleading. Many elements simply cannot be quantified, for example, cultural factors like individual understanding of welfare*.' (C1).

4.2.3. Research institutes and think tanks

Respondents reported that policy appraisal in China is performed by both civil servants and external consultants. The usual practice is for appraisal to be undertaken by '*the government or the offices that are responsible for policy implementation*' (C6). However, government-affiliated research institutes, higher education institutions, and think tanks also contribute (C4). This approach is perceived as less standardized, partly because of the lack of clear guidelines and the fact that more organizations are involved. Respondents stressed the need for the institutions responsible for the policy appraisal to be objective, independent, and transparent, which may be hindered by close affiliation with the government and political sensitivity. Despite the limitations, one respondent highlighted the efforts being made by the government to support research aimed at improving policy analysis and '*ensuring effective implementation*' (C4).

4.2.4. Appraisal guidelines

While policy appraisal in China is viewed by respondents to be flexible, with decisions made on a case-by-case basis, our document review uncovered written guidelines for the appraisal of major administrative decisions (The State Council, 2019). In force since 2019, the purpose of these guidelines is to standardize decision-making procedures and to improve the outcomes and efficiency of decision-making. The guidelines require that financial, environmental and social costs and benefits are estimated, but they do not stipulate explicitly that a CBA must be undertaken. Furthermore, there does not appear to be any prescribed method for undertaking this analysis. Guidelines require some form of public participation, and where decision-making is particularly specialized, expert consultation is also necessary.

No respondents were aware of the existence of these or any other policy appraisal guidelines neither at the national nor the subnational level. One respondent explained, '*there are no such normative documents in place, nor mandatory requirements in practice*' (C3). Another respondent also acknowledged that '*China does appraisal meticulously, which includes, for example, coordination between departments and expert consultation. But, perhaps, there are no specific written requirements and procedures*' (C6). This could be because the guidelines are relatively new and had only been in place for around 18 months at the time of the interviews.

4.3. India

Introduced by the Government of India in 2015 to replace the Planning Commission, the NITI Aayog ('Policy Commission' in English) is the main organization responsible for the design of long-term public policy in India (NITI Aayog, 2021). It works with and supports government ministries in the planning, implementation,

and monitoring of policies and programmes (MoEFCC, 2021). It is also responsible for the integration of evidence-based policymaking into the Indian governance structure. In the context of climate change and low-carbon innovation, the Ministry of Environment, Forest and Climate Change, the Ministry of Power, the Ministry of New and Renewable Energy, and the Ministry of Coal are all influential ministries.

Within the NITI Aayog, there are different units (known as 'verticals'), which are responsible for the examination and design of relevant projects or policies, and which interact with the appropriate ministries (NITI Aayog, 2021). The area-specific verticals are supported by cross-cutting units such as the Development, Monitoring and Evaluation Office (DMEO) or the Project Appraisal and Management Division (PAMD). These units are also under the supervision of the NITI Aayog. While appraisal is typically conducted by the relevant verticals, the PAMD is responsible for programmes that incur a cost above Rs 500 crore.[2] CBA is required wherever project returns are quantifiable. A risk analysis should also be undertaken, considering legal, environmental and regulatory risks among others, but it is not specified when and for what kind of proposals this is required (PAMD, 2016).

4.3.1. Use of CBA and MCA

The use of CBA for policy appraisal in India appeared widespread from respondents' responses. One respondent referred to CBA as '*the basis of all policy appraisals*' (I3) whilst another referred to it as *'kind of a favourite'* (I8) at the national level. Although not as prevalent, MCA is also used in India, especially where unquantifiable factors must be considered. One respondent explained: 'the advantage *[of MCA] is that you are able to consider a lot of soft factors which are very important, a lot of social factors which are very important' (I7).*

One respondent highlighted that the methods used in the formulation of a policy are '*never disclosed by government agencies*' (I6), resulting in uncertainty regarding how policies are chosen. This impedes the ability of non-government actors to offer feedback on the process. Another problem highlighted was the tendency to perform quantifications of costs and benefits without fully understanding the underlying assumptions behind those numbers. One of the respondents described this problem as '*ideological*' and '*fundamentally flawed*' (I1) and another highlighted that some social impacts are not quantifiable, such as '*the pain of displacement of native tribes*' (I7).

Some respondents mentioned the use of more sophisticated approaches such as optimisation-based models, general equilibrium, and partial equilibrium approaches, particularly in areas such as energy and trade. Sensitivity analysis is commonly undertaken and reported but is not incorporated into all models. Unquantifiable factors and uncertainty are sometimes considered but this is not a fixed requirement and is often at the discretion of the analyst.

4.3.2. Outsourcing and tight timeframes

Respondents reported that the appraisal process in India is carried out by a range of government and non-government actors. This includes global consultancy firms, who bid for appraisal jobs through a tender process where the assignment is typically awarded to the least-cost bidder. This could undermine the robustness of the appraisal outcome as often the bidders are not equipped with '*a solid methodology for that kind of analysis*' (I7). Another problem highlighted was the tight timeframes provided by the government to develop the analysis. As explained by a respondent, delegated consultants are frequently given a few weeks to do an appraisal in what should take '*at least a year*' (I9).

4.3.3. Appraisal guidelines

An issue raised by several respondents was the lack of standardization in policy appraisal practice, which according to them was linked to the absence of '*consistent government guidelines*' (I7). Some respondents highlighted that this also leads to difficulties in maintaining appraisal consistency across government departments. One respondent commented that the lack of guidelines leads to an inconsistent and '*official-centric*' approach (I7).

Despite this, two respondents mentioned that policy appraisal guidance at the national level is '*publicly available*' (I4). Furthermore, our literature review uncovered general guidelines for the appraisal and approval

[2]Approximately $60 million (exchange rate as of December 2022).

of publicly funded schemes and projects, published by the Project Appraisal and Management Division (PAMD, 2016). However, from a methodological perspective, these guidelines only provide a general description of how appraisal should be performed. For instance, they mention that 'financial and economic cost–benefit analysis of the project should be undertaken wherever such returns are quantifiable' (PAMD, 2016, p. 9). However, the document does not specify how to do such an analysis. Similarly, the guidelines mention the use of benefit–cost ratios for viability and sustainability analyses but do not provide any information on how benefits should be quantified. Consequently, while formal guidance for appraisal is present, it does not include a detailed methodological description to guarantee a homogeneous application of CBA or other appraisal methods across government departments.

4.3.4. Centralized decision-making and public consultation

Respondents suggested the centralized nature of the decision-making process can sometimes hinder well-formulated policy. One respondent highlighted how centralized the policy-making process is at the national level, especially around the Prime Minister. '*[E]ven if you follow all best practices in the formulation of a policy, the ultimate approval process is pretty unilateral*' (I6). At the sub-national level, responsibility for the decision-making process lies with Principal Secretaries appointed by the Chief Minister. '*[T]he policy formulated depends entirely on the priorities of the government department in control of the formulation process*' (I6). Where policies or projects have the potential to impact citizens, respondents suggested public consultations are supposed to be a mandatory part of the appraisal process, which could contribute to the formulation of a shortlist of policy or project proposals.

5. Discussion

When formulating climate and energy policies, the appraisal process is crucial not only to ensure the efficient use of public resources, but also to understand the potential impacts of policies on the environment, health, and a wide range of other areas. Our findings show that traditional monetary and quantitative analysis was perceived as not entirely appropriate in every situation by many respondents. The limited capacity and the lack of standardized guidelines were also highlighted in the interviews. Significantly, measures have been adopted to improve the policy appraisal processes, for example, by using legislation to make appraisal mandatory for some types of policies, by creating guidance to standardize appraisal processes and methods, or by developing more sophisticated tools to capture the broader social impacts of policies. However, substantial differences exist among different countries in challenges and solutions. The following section outlines the common factors and compares the differences in detail in four aspects: approach, limitations, solutions, challenges and opportunities.

5.1. Approach: CBA is widely used and there is awareness of its limitations

There is a common trend towards institutionalizing the appraisal process and increasing the reliability of this element of decision-making. Although each country differs in terms of the level of standardization and application, they all have official policy guidelines either requiring or recommending the use of policy appraisal methods. The extent to which these guidelines specify how policy appraisal is to be performed, and which method(s) must be used, varies significantly between countries. In Brazil, detailed guidelines on the application of CBA exist (SEPEC, 2021), whereas in China and India, guidelines are much less prescriptive and more general (PAMD, 2016; The State Council, 2019).

In Brazil and India, CBA is the prevailing policy appraisal method, while in China, MCA is dominant. Respondents from all countries showed familiarity with the computational tools used for policy appraisal, including scenario analysis, computational general equilibrium modelling, and energy systems modelling. The use of these approaches, however, was contingent upon having the teams with the required technical skills, which were often limited. Consequently, there are significant differences in how these tools are used across countries and government departments within the same country.

While CBA is widely applied because of its advantages in reliability and straightforwardness, its limitations were acknowledged. Limitations emphasized by respondents included a reliance on monetizing different

factors, many of which are unquantifiable. This includes policy impacts on the environment, health, and well-being. The scepticism shown toward CBA and its output expressed here is similar to the views of some practitioners in the Global North (Annema et al., 2015). Other methods, including MCA, incorporate such unquantifiable factors into the analysis more effectively. However, the application of MCA presents disadvantages regarding the formulation criteria of policy goals and variables, and the subjectivity of the analysis, as the weight assigned to different factors is decided under individual judgment.

5.2. Limitations: political nature and limited impacts

Although the policy appraisal process intends to make policy decision-making more 'science-based', it should be acknowledged that policy appraisal is itself a political behaviour, subject to different political cultures, institutions, instruments, and interests (Turnpenny et al., 2009). Appraisal is an important factor in the decision-making process in each of the three countries, but it is not necessarily the most decisive. In all three countries, respondents highlighted the fact that policy appraisal results can have a limited impact on actual decision-making and political considerations tend to have a heavier weight, especially at the ministerial level. The appraisal results are therefore just one, and not necessarily the main, input for final decision-making. This reflects a finding from OECD (2018), which identifies that policy decisions are frequently made in a manner that is inconsistent with the CBA result. That said, the evidence gathered through appraisal bears a legitimacy effect (Turnpenny et al., 2009), where proposals can be better defended or challenged within the political sphere.

Public participation has been recognized as an important part of policymaking, particularly in China and India. In terms of implementation, some provinces and cities in China have detailed procedures on how to organize public hearings, consultations, and communication (People's Government of Guangdong Province, 2021; People's Government of Xinjian District, 2020). This development is in contrast to the longstanding lack of sufficient and meaningful public participation in the past. The extent to which these procedures are implemented and the actual impact of public participation on policy decisions, however, is less clear (Zhang et al., 2019; Zhou et al., 2019).

5.3. Solutions: efforts to improve appraisal approaches

To improve the robustness of policymaking, all three countries are reforming policy appraisal procedures and methods. Despite the limitations of appraisal methods, there is a clear demand for ex-ante appraisal to help ensure policy objectives are met or to justify a policy. There are ongoing efforts to improve and update models, facilitate institutional practice, and bring in higher policy objectives. In Brazil, training schemes, workshops, and international collaboration form part of wider capacity building, which is key to strengthening the capacity of policy analysis (Howlett, 2015). In China, the state has formalized appraisal requirements by publishing mandatory regulations in 2019. Meanwhile, India is strengthening impact assessment for proposed legislation and policies. While we found that relatively new guidelines exist, the interviews show that the awareness and application of such documents are limited. Capacity constraints, limited awareness, and lack of political will are impeding a broader application (Som & Naru, 2017). Nevertheless, capacity-building initiatives are in place to provide toolkits and guidance, and facilitate knowledge sharing within the government and international counterparts.

5.4. Challenges and opportunities

The success of efforts targeted at improving policy appraisal lies not only in specific approaches and their application, but also in the broader political institutions and contexts. Some of the motivations for enhancing policy appraisal include reducing misuse or abusive use of political power, and increasing consistency, accountability, and efficiency in decision-making (Li & Zhu, 2010). For transformative policy changes that pose greater risks and uncertainties, the importance of policy appraisal should be further emphasized.

The appraisal methods themselves present another challenge. CBA provides a valid and straightforward quantitative framework for calculating costs and benefits, but there are many uncertainties related to the outcome, including the choice of discount rate and the treatment of innovation. Where inputs are particularly

uncertain, CBA becomes more subjective, with the imputation of missing values and the inclusion of some factors and the exclusion of others. Clearly communicating uncertainty to policymakers is therefore important, and where certain values must be assessed through expert judgment, mechanisms should be in place to prohibit misuse. Furthermore, an overreliance on numbers and models could be dangerous, especially when the costs and benefits are unquantifiable or unknown, while broader social implications might not be considered. The marginal improvement of approaches like CBA and MCA will address part of these issues but seem unlikely to solve them entirely. New approaches are likely necessary to better incorporate unquantifiable factors, risk, and uncertainty into the policy process.

6. Conclusion

In this study, we find that CBA has a significant role in the policy appraisal systems of Brazil and India, but substantially less so in China where MCA is dominant. All countries are reforming and strengthening their appraisal systems with various approaches and progress. According to the interviews, appraisal practitioners and policy experts are aware of the limitations of CBA, but practitioners, in particular, also highlighted the strengths of the framework, specifically its robustness and consistency.

More generally, respondents pointed to challenges regarding the standardization of appraisal, the availability of data, and capacity building. Whilst there are ongoing efforts in each country to improve the effectiveness of policy appraisal, CBA faces clear fundamental limitations that are likely to require the use of additional methods to appraise the transformative policies necessary to achieve emission targets.

Several policy insights can be drawn from the study that could contribute to improving the policy appraisal systems in emerging economies. First, different appraisal approaches may lead to different policy choices. Appraisal approaches should be supplemented and diversified according to the designed policy goals. Limitations of approaches should be considered and clearly disclosed. Second, appraisal should be undertaken by policy experts who have the relevant knowledge and experience but should avoid conflicts of interest. The choice of experts can help not only during policy design but also in the phase of policy implementation. Third, laws and regulations, policy documents and guidelines could help to standardize appraisal systems, which is important to increase its influence in policymaking and the accountability of policy. Fourth, the integration of uncertainty analysis in policy appraisal can bring benefits, particularly when assessing climate and energy policies that aim to mitigate highly uncertain climate damages. Fifth, the specific context where policy appraisal is applied must be considered with care. The unique situation of each country, province, city, sector, and policy should be taken into consideration.

In response to the shortcomings of the current appraisal systems highlighted in the paper, we believe that work is needed to develop new approaches for assessing transformative policy options. As well as conceptual frameworks, this will require the improvement of existing approaches and the creation of novel computational models that better incorporate system feedback and uncertainty. More work is also needed to better understand the dynamics that exist between decision-makers and policy analysts, as well as the motives driving policymaking in developed and emerging countries, and how these might differ. This will also help to uncover the extent to which the appraisal process contributes to the final policy decision in lieu of political considerations.

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