Katowice Committee of Experts on the Impacts of the Implementation of Response Measures

Fifth meeting

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Facilitating development, enhancement, customization and use of tools and methodologies for modelling and assessing the impacts of implementation of response measures, including identifying and reviewing existing tools and approaches in data-poor environments, in consultation with technical experts, practitioners and other relevant stakeholders

Draft technical paper

Activity 3, workplan of the forum on the impacts of the implementation of response measures and its Katowice Committee of Experts on the impacts of the implementation of response measures

Executive Summary[1]

1. Impact assessment is at the core of discussions on response measures. Assessing economic, environmental, and social impacts of the implementation of response measures can support efforts to minimize their adverse impacts and maximize positive impacts.

2. The technical paper and accompanying database provide detailed information about a number of tools and methods available to be developed, enhanced, customised, and used for modelling and assessing the impacts of implementation of response measures, thereby helping to lower the informational barrier faced by potentials users of such tools and methods. The database is compiled through stakeholder interactions with the authors and developers of the tools and methods via an online survey.

3. Quantitative and qualitative methodological approaches complement each other when performing assessment and analysis of impacts of implementation of response measures. Quantitative *methods* include:

(a) Computable General Equilibrium models: Whole economy models based on economic data.

(b) Integrated Assessment Models: Models that integrate geophysical and economic systems.

(c) Macroeconometric models: Behavioural equations estimated from national accounts data.

4. Qualitative *methods, that collect data using, for example, observation, interviews, and reviewing text, can* provide context specific insights, increase transparency in the policy development process and can validate empirically quantitative findings, improving the quality and relevance of impact assessments.

5. The application of models can require large amounts of data that needs to be available, accessible, and reliable. The provision of complete and consistent databases can be a limiting factor in the use of tools and methods for assessing the impact of the implementation of response measures, particularly in developing countries.

6. A selection process developed by the authors can support Parties and stakeholders in identifying the most appropriate tools and methods for their context, via 3 overarching steps:

(a) Shortlist available tools and methods using general criteria (suggested below).

(b) Narrow the shortlist further using user specific criteria.

(c) Compare the detailed summaries of the possible tools and methods.

7. Four general criteria are suggested: Types of impacts, Scale, Approach, and Training and ongoing support, which are complemented by user specific criteria. The detailed summary provided for each tool and method covers impacts, availability and quality of data/information, costs, applications and training and support.

8. Based on the analysis, five recommendations that can assist Parties with facilitating the development, enhancement, customization, and use of tools and methodologies for modelling and assessing the impacts of the implementation of response measures are:

(a) Regularly update the existing UNFCCC database[2] of tools and methods for assessing the impacts of the implementation of response measures, as needed and as appropriate

(b) Develop and maintain a web-based user interface for selecting tools and methods, as needed and as appropriate, and promote its use among the Parties and stakeholders.

[1] The KCI is grateful to the consultants who were involved conducting the survey and drafting this technical paper.

[2] https://unfccc.int/topics/mitigation/workstreams/response-measures/modelling-tools-to-assess-the-impact-of-the-implementation-of-response-measures

(c) Consider the availability of expertise within the country looking to undertake the assessment, training and support, and consultancy services when selecting a tool or method.

(d) Invest in data collection, if possible, in line with national and/or international standards (for example, the UN System of National Accounts (SNA) or the UN System of Environmental-Economic Accounting (SEEA).

(e) Increase the representation of developing countries in the use and development of impact assessment tools and methodologies through capacity building partnerships and networks.

I. Background

A. Introduction

9. Impact assessment is at the core of discussions on response *measures (UNFCCC, 2016a). The* technical paper contributes to the KCI 6-year workplan, activity number 3 (UNFCCC, 2020), by providing detailed information about a range of tools and methods that are available to be developed, enhanced, customised, and used for modelling and *assessing the impacts of implementation of response measures*. The information provided in the technical paper and accompanying database aims to lower the informational barrier faced by potential users of tools and methodologies for impact analysis.

10. Assessing the impacts of the implementation of response measures allows efforts to be made to minimize adverse impacts (Article 2.3 & 3.14 Kyoto Protocol (United Nations, 1998); Article 4.8 & 4.10 of the UNFCCC (United Nations, 1992) and maximize positive impacts of the implementation of response measures (Decision 7/CMA.I Annex I 1(f) Katowice Climate Package (UNFCCC, 2018).

11. Response measures has been defined "by some authors as "actions, policies, and programmes that countries, as Parties to the UN Framework Convention on Climate Change undertake in response to climate change, mostly for mitigation of greenhouse gas (GHG) emissions" (Anger-Kraavi & Chan, p.1, 2021) and the impact of the implementation of response measures as impacts arising from the implementation of response measures including, inter alia, economic, social, environmental, domestic, cross-border, positive, and negative impacts.

12. The impacts of the implementation of response measures may be positive (co-benefits) or negative and affect some or all dimensions of development: economic, environmental, and/or social (see Markkanen & Anger-Kraavi, 2019) for a discussion of social and inequality impacts). Examples of impacts include improvements in relative competitiveness in a non-implementing country through 'carbon leakage' where the introduction of carbon taxes raises the price of exports in the implementing country (economic), boosting employment in export-orientated sectors (socioeconomic) and increasing domestic emissions (environmental).

13. It is widely acknowledged that policy implementation carries the potential for both synergies and trade-offs between different dimensions of development (Philippidis et al., 2020), that is positive and negative impacts. It is important that policy makers have access to information about the full range of possible impacts o make policy decisions based on a comprehensive understanding of the likely impacts, in order to maximize the positive and minimize the adverse impacts. An understanding of the type of impacts is an important component in the process of identifying and selecting appropriate tools and methods for impact assessment.

B. Discussion of approaches

14. Tools and methods for modelling and assessing the impact of the implementation of response measures span quantitative and qualitative approaches. For example, a survey question about the expected impact of response measures on employment may be defined quantitatively: -5%, -10% etc. or qualitatively: 'slightly worse', 'significantly worse' etc.

15. Quantitative methods dominate the field of existing efforts to assess the impacts of the implementation of response measures including efforts to use 'big data' to examine the impact of climate response measures (Wong, 2019). Some studies employ mixed methods using qualitative and quantitative data to examine impacts of response measures (Reis Teixeira da Costa et al., 2019; Neofytou et al.,2020). Qualitative and quantitative methodological approaches can complement each other when performing assessments of the impacts of implementation of response measures. A method should be selected based on its adequacy to the objective of the assessment and the aspects under investigation.

II. Objective and Scope

16. Set against this background, the objective of the technical paper is to provide detailed information about tools and methods that are available to be developed, enhanced, customised, and used for modelling and *assessing the impacts of implementation of response measures in order to maximize the positive and minimize the possible adverse impacts.* The paper, alongside the accompanying database, provides information to Parties and stakeholders to assist them in the selection of methods *thereby* aiming to lower the informational barrier to accessing tools and methods for impact analysis. The technical paper builds upon previous work (UNFCCC, 2016a) and updates and extends the publicly available database of tools and methods[3] with information collected through a survey. This means that authors and developers of the tools and methods are included in the process of information collection as stakeholders in the provision of tools and methods for impact assessment.

17. The structure of the technical paper is as follows: an introduction to the assessment methods including the strengths and weaknesses of each approach is given in section III. A discussion of data requirements is presented in section IV. A guide to the process of method selection, including selection criteria is presented in section V, followed by a discussion of cost effectiveness in section VI. An overview of the survey used to gather up to date information about available methods and a summary of the database are presented in section VII. Section VIII includes the concluding comments and recommendations arising from this technical paper.

III. Introduction to the assessment methods

18. An introduction to the main approaches used in the modelling and assessment of the impact of the implementation of response measures is given in this section. The discussion serves to introduce a common understanding of the terminology and different aspects of the methods including strengths and weaknesses, dynamics, and the handling of uncertainty.

19. The assessment methods were identified using a combination of literature review, KCI members' and consultants' expert knowledge of the field. This approach led to the identification of 94 tools and methods that may be suitable for the assessment of the implementation of response measures. A list of the tools and methods is provided in Table in Annex A.

20. The scientific and grey literature on assessing impacts of the implementation of response measures reveals approaches described in the table 1 below (see Annex B for a description of the literature search).

21. These four approaches are highlighted here because they are among those most often used for this purpose. Other tools and methodologies can be used to model and assess impacts, including expert consensus surveys (see for example, Howard & Sylvan, 2015) and emerging artificial intelligence/machine learning type of models, system dynamics models.

[3] https://unfccc.int/topics/mitigation/workstreams/response-measures/modelling-tools-to-assess-the-impact-of-the-implementation-of-response-measures

Table 1: Identified approaches for assessing impacts of the implementation of response measures

Quantitative tools:
Computable General Equilibrium (CGE) models
Whole economy models based on economic data.
Integrated Assessment Models (IAM)
Models that integrate geophysical and economic systems
Macroeconometric models
Behavioural equations estimated from national accounts data.
Qualitative tools/mixed methods:
Approaches such as surveys that collect non-numerical and/or numerically descriptive data for analysis.

A. Computable General Equilibrium models

22. Computable General Equilibrium (CGE[4]) models are the most widely represented approach among impacts assessments of response measures (see Mani et al. (2018), Kompas et al. (2018) and Vrontisi et al. (2020)). CGE models are whole economy models based on economic theory, populated with real economic data which depicts the economy in a given year (base year). The models are deterministic systems of equations which represent the behaviour of firms, households, and governments. As such, CGE models do not deal with uncertainty in a stochastic sense, however, uncertainty around policy specifics can be introduced through running a range of simulations i.e carrying out sensitivity analyses. CGE models can be used to assess impacts of a range of policies on economic variables. Depending on the model CGE models may be used for comparative static analysis, allowing for a comparison of the state of the economy before and after a policy change, or recursive dynamic analysis, allowing for a comparison of the development of the economy over time with and without a policy change.

23. CGE models can be global, national (or single country), or regional models. National CGE models can carry the advantage of more detail, for example, on sectors, households, and other domestic institutions. In contrast to global CGE models which often have a single representative household (with the exceptions, for example, of the MyGTAP, GLOBE/ANARRES, MAGNET, and MIRAGE-HH models), The representation of multiple household groups in some national CGE models allows for analysis of the impact of the implementation of response measures on different types of households including income distribution (e.g. Huang et al., 2020 study on China's income gap and inequality under clean energy transformation). Additionally, national CGE models can offer a greater scope for including specific features of an economy such as home production for home consumption and gender (e.g, Severini et al., 2019). Examples of assessments of the domestic impacts of climate response measures include the impact of an Emissions Trading scheme in China (Lin & Jia, 2017), evaluating carbon tax impacts in Spain (Freire-Gonzalez & Ho, 2019) and in Latin America and the Caribbean (Chisari & Miller, 2015).

24. While many studies combine domestic and cross-border impacts in the same analysis (e.g. Golub et al., 2013; Paruossos et al., 2019; Chai et al., 2019) , there are some studies that focus on isolating the cross-border impacts of response measures for example Jooste et al.

[4] CGE models are similar to Dynamic Stochastic General Equilibrium (DSGE) models. Both model classes are based on microeconomic foundations rather than historical relationships. The main difference between the two types of model is DSGE models attempts to capture fluctuations in business cycles whereas CGE models tend to focus more on medium-run and long-run macroeconomic analysis. Standard DSGE models also tend to have less detailed representation of firms and households than CGE models. On the other hand, DSGE models allow for random variations to account for uncertainty whereas CGE models are deterministic, with agents facing no uncertainty about the future. Based on: HMRC's CGE model documentation, December 2013 available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/263652/CGE_model_doc_131204_new.pdf

(2009) identify the winning and losing energy intensive and trade-focused sectors in South Africa under 2 emission reduction scenarios and 3 emissions trading assumptions. Another recent study, which uses a global (GLOBE) and a national CGE model (STAGE), isolates the impacts of the implementation of response measures for Senegal and Kenya (UNFCCC et al., 2021). The authors present impacts on key economic outcomes and also on a set of SDG indicators spanning SDGs 8, 9 and 10, for 3 possible response measures: a carbon tax, an energy input tax, and a quantity restriction. The study finds the impacts depend greatly upon the type of response measure implemented, with more muted effects under a carbon tax.

25. Other examples of national CGE models in multi-model approaches include Weitzel et al. (2015) in which a national CGE model for India (IEG-CGE) is 'soft-linked' to a global CGE model (DART) and used to analyse the welfare effects of an international climate regime in line with a two-degree target under varying assumptions about international price effects, international transfers and allocation of carbon tax and transfer revenue. Here, the impacts are a combination of domestic and cross-border impacts as India is included as part of the international regime. This is also the case in Johansson et al. (2015) in which a suite of 7 'soft-linked' climate policy, global CGE, national CGE and energy models are used to examine the gains/costs and welfare implications of a two-degree climate scenario with emissions trading in India and China. More recently, Gupta et al. (2019) combine a top-down economy wider model of India (IMACLIM) with a bottom-up energy system model (AIM/Enduse) to examine the macroeconomic impacts of a low-carbon pathway under different growth assumptions.

26. The strengths of the CGE approach lie in the depiction of the whole economy and the ability to capture both direct and indirect effects The latter are the higher-order effects of a policy changes as it 'ripples' through the different parts of the economy for example through linkages between economic sectors that stem from input-output or supply and use tables.

27. The models also include several 'levers' e.g., tax instruments, consumer preferences which allow for the modelling of a wide range of policies. Moreover, the models can be extended to capture particular economic features such as imperfect competition, skilled and unskilled labor, unemployment, and broader set of indicators e.g., to show the impact on SDG indicators.

28. The limitations of this approach include high data requirement, reliance on empirical data from one year, and the dependence on the selected parameter values such as elasticities. In addition, there have been several challenges to the economic theory underlying most modern CGE models. These concern, for example, assumptions such as rational and representative agent with immense computational capacities, perfect costless information, complete markets and aggregate production functions (e.g. Babatunde et al., 2017; Haldane and Turrell, 2018; Ackerman, 2002). In simulating climate change mitigation measures these weaknesses could potentially lead to wrong policy response (Stern, 2016)

B. Integrated Assessment Models

29. Integrated Assessment Models (IAM) can be defined as whole economy models that integrate knowledge from two or more domains of knowledge, in policy optimisation or policy evaluation modes. In the context of the analysis of climate change, models that integrate geophysical stocks and flows with economic stocks and flows can be classified as IAMs. Policy optimisation IAMs can optimise objective (welfare) functions over extended (quasi-infinite) time horizons, while policy evaluation IAMs can generate pathways for important variables, geophysical and economic, using recursive or (constrained) equilibrium methods (see Nordhaus, 2013, p 1080). Both modes are 'dynamic' with the optimisation mode using intertemporal dynamics and the evaluation mode being, primarily, recursive dynamic.

30. The modelling of economic systems ranges from highly aggregated, as in the DICE/RICE (Nordhaus, 2013) and MESSAGE-GLOBIOM (Krey et al., 2020) models, to multi-sector and multi-region whole economy models, as in the EPPA (Chen et al., 2016) and ENV-Linkages (Chateau et al., 2014) models.

31. The modelling of geophysical systems is more nuanced, reflecting the greater complexity of geophysical systems: consequently, IAMs typically include components of geophysical systems. A 'basic' IAM might include modules that record energy use and emissions, e.g., ENV-Linkages (Chateau, et al., 2014) whereas more complex IAMs might include feedback relationships between, say, CO_2 emissions, temperature increases and land productivity, e.g., EPPA (Chen et al., 2016). The complexities of geophysical systems mean that IAMs will, typically, provide partial representations of geophysical relationships. This is one of the weaknesses of IAMs.

32. The range of geophysical relationships that can be included in an IAM is extensive. These might include:

(a) energy use

(b) anthropogenic GHG emissions and air pollutants

(c) marginal abatement curves for emissions

(d) land use by agro-ecological zone

(e) water use

(f) carbon cycle

(g) climate sensitivity

(h) natural resources (non-renewable and renewable)

  a. stocks

  b. extraction rates/optimal extraction rates

(i) damage functions related to, for example,

  a. sea level changes

  b. temperature changes

  c. rainfall changes

(j) feedback effects related to, for example,

  a. land productivity

  b. human and animal heat stress

  c. health, e.g., spread of anopheles mosquitos (malaria), tsetse fly (trypanosomes)

33. When selecting an IAM for a specific analysis it is essential to take account of the geophysical systems included in the model.

34. As with CGE models, IAMs are analytical models that provide an environment within which responses by an economic system can be better understood. The strengths of these models derive primarily from their systematic organisation of interactions, which provides a framework within which users can interpret complex geophysical and economic systems. Despite many IAMs being complex, their modelling of geophysical and economic systems are necessarily simplifications, which means that some relationships are omitted and/or underspecified, often there is a lack of transparency around model structures and input assumptions (e.g. Gambhir et al., 2019; Skea et al., 2021), and risks are not accounted for (Stern, 2016) These can be seen as some of the weaknesses of IAMs.

C. Macroeconometric models[5]

35. The earliest large-scale model of a national economy is that of Jan Tinbergen (1939). Although there are many antecedents going back to the 19th century (Bodkin et al., 1991), his was the first estimated large-scale model based on US data from 1919 to 1932. The work

[5] An alternative term is macroeconomic models

of Tinbergen was then superseded by Klein (1950), who published 3 different versions of a model of the US economy, each of increasingly larger scale However, these models were largely testbeds for checking their computational needs, investigating estimation methods and exploring the challenges of modelling simultaneous equations. The major breakthrough had to wait for the 1960s with the greater availability of quarterly national accounts and greater computational facilities (Duesenberry et al., 1965). The current generation of macroeconometric models, especially those for the world economy, incorporate sectoral disaggregation, input-output tables, with dependencies between countries captured through trade in goods and services, and integrated financial markets. These models share many features of the CGE and IAM approaches. However, they differ in terms of market clearing. CGE and IAM are Walrasian general equilibrium models where markets clear. However, in the majority of macroeconometric models a short run nominal shock affects both quantities and prices

36. Their use for assessing the economic impacts of climate change and climate policies for the world economy relies mainly on two approaches. The first uses a reduced form damage function from cross sectional studies to determine both the sectoral and economy wide impact of temperature etc., on economic activity (Burke et al., 2015; Neumann et al., 2020). The other approach builds in explicit energy and emission sub-models that allows for feedback the economy (Cambridge Econometrics, 2019).

37. Although there are many overlaps between different types of models, a commanding feature of macroeconometric models is the use of the structure of the national income, expenditure and product accounts; their use of econometric methods appropriate to non-stationary economic processes (cointegration, error correcting) and in particular at the level of the world economy, integrating countries into a global framework, with interactions captured though trade in goods and services, exchange rates and financial markets.

38. Traditionally in the 50 years or so that these models have been used by finance ministries and central banks they have been used for economic forecasting and economic policy analysis. It is only more recently that they have also been used for climate change policy analysis. The types of effect that the models can capture depends on the particular way in which they build in how climate change interacts with the economy, social features (such as income distribution) and the environment.

39. If macroeconometric are to be used for modelling and assessing the impact of the implementation of response measures it is important that there is a degree of sectoral breakdown so that, for example, the effects of impacts on agriculture can be differentiated from their impact on manufacturing or service industries. It is also important that there is a feedback between economic activity, the energy system, and emissions of greenhouse gases.

40. This type of models are very data intensive requiring timeseries data over several decades, compared to CGE models that usually use data from one year (base year). They are often also labour intensive since econometric parameters need to be re-estimated when new data becomes available or there are data updates. Macroeconomic models have also been critisised for their reliance on relationships observed in historical data, rather than on economic theory, because if policy rules change then these relationships will also change (Lucas, 1976), These are some of the weaknesses of this type of model.

D. Qualitative and mixed methods

41. The use of non-quantitative methods to assess the impact of the implementation of response measures is less represented as modelling studies in the scientific and grey literature, although some studies have promoted the use of qualitative and mixed methods. Examples of qualitative and mixed methods include a multi-criteria decision analysis combined with input-output analysis to assess the impact of energy-efficiency policies in Greece (Neofytou et al., 2020), and a methodology for reporting on the impacts of response measures using country case studies (Reis Teixeira da Costa et al., 2019). The 9-step approach in the latter method combines quantitative and qualitative evaluations, including stakeholder inputs, to identify vulnerable sectors. The impacts of international and domestic response measures are then assessed and possible tools for addressing the impacts are identified.

42. Qualitative methods can provide context specific insights, increase transparency in the policy development process (UNFCCC, 2016a) and validate quantitative findings, improving the quality and relevance of impact assessments. Qualitative assessments are generally carried out to gain a broad understanding of the issue being investigated in order to obtain a full picture and are more in depth in comparison with quantitative assessments. Qualitative methods produce non-numerical and/or numerically descriptive results and/or numerical data and can be used to further understand the impacts of a policy in relation to specific issues being investigated as part of a particular study, such as impacts on livelihoods for a particular group of society (including gender impacts) or behavioural changes resulting from the implementation of a specific policy. Qualitative assessments entail studying the potential impacts from the perspective of people and rely on information collected, instead of generating figures and numbers based on existing data as it is used in the quantitative assessment methodologies. The results of a qualitative method can be classified in terms of the likelihood, magnitude, and nature of the impact (positive or negative). Qualitative assessment methods include observations, surveys, in-depth interviews and focus group discussions. Desk reviews of published information are also used as part of a qualitative assessment.

43. Qualitative methods can also be time and labour intensive. The sample size used to generate data for a qualitative assessment is typically smaller than that used for a quantitative assessment and can be more cost-effective and less time consuming than building a new model in a data-poor environment. The findings from qualitative assessments arise from the contributions of the participants so may be subject to their availability and willingness to respond. CGE, IAM and macroeconometric models do not include most aspects of behavioural change, if any, and are not suitable for studying social protection and social dialogue in the context of transformation to low carbon economy.

IV. Data Requirements

44. High quality impact analysis relies on availability and accessibility of high quality and accessible data without which assessments cannot be conducted, even if the tools themselves are available. Indeed, the provision of complete and consistent databases is a limiting factor in the use of tools and methods for assessing the impact of the implementation of response measures.

45. Some tools require detailed long period time series data, e.g., data for macroeconometric models, while other models require detailed cross-sectional data, e.g., from Social Accounting Matrices (SAMs), which are matrix-based representations of national accounts, and relevant satellite accounts[6]. Supplementary data such as energy data, greenhouse gas inventory data, and environmental economic data are frequently used to extend the coverage of impact assessment tools. As such, the data requirements of quantitative impact assessment tools are high.

46. The most commonly used international standard for national (economic) accounts is the System of National Accounts (SNA) (ISWGNA, 2009) and for environmental-economic accounts is the System of Environmental-Economic Accounting (SEEA) (UNCEEA, 2014). Ideally, the data used for CGE, IAM and macroeconometric models should be ‘complete and consistent’ and if possible conform to national and international standards (such as the SNA and SEEA): ‘complete’ in the sense that all transactions are represented/reported and ‘consistent’ in the sense that expenditures by one account are also recorded as incomes by another account. The reliability of the data used should be judged accordingly.

[6] “National accounts statistics are key indicators for describing the national economy and its interactions with the rest of the world and thus, fundamental for economic analysis and research, monitoring and evaluating the performance of an economy, policy formulation, decision-making, and good economic governance.” (https://www.uneca.org/foucusareaesna/pages/economic-statistics-and-national-accounts)

47. Those commissioning studies should have confidence that the data conform to high standards while those conducting studies should demonstrate that any deviations for the standards are justified.

48. Qualitative impact assessment methods can generate data and hence may not require significant data at the outset.

A. Single Country Data

49. The economic and environmental data for individual countries are compiled at the discretion of decision makers in individual countries. Ideally, macroeconomic data (such as GDP, employment) will be recorded at least annually, and often quarterly, using consistent definitions and methods with minimal lags and subject to frequent reviews and regular benchmarking exercises. Disaggregated national data will, typically, be produced based on periodic census, e.g., census of manufacturing, and surveys, e.g., household income and expenditure labour force survey, data; these product balance data will often be presented as supply and use tables (see ISWGNA, 2009, chapter 14) that are often used for benchmarking the national accounts. Resource constraints can mean that some censuses and surveys are not undertaken annually and, therefore, disaggregated national accounts may be produced at intervals: e.g., every 5 to 10 years.

50. Single country data should be 'complete and consistent'; 'consistency' is relatively straightforward, e.g., ensuring the row and column totals equate in matrix representations. Checking for 'completeness' is more difficult can be more time consuming since it requires identifying any missing and/or inaccurate transactions, which requires detailed knowledge and information about an economy and can be difficult. All published national account data should strive to be 'consistent' (reconciled), though this cannot always be guaranteed.

51. If a national accounting system does not produce environmental and/or economic data, users of single country databases for climate change and environmental-economic analyses may need to generate and/or access the required data elsewhere,

B. Global Data

52. If possible, databases for global models should also be consistent with national and international standards (such as the SNA and SEEA) and be compiled from 'complete and consistent' national databases. There is no single global international agency responsible compiling such global databases, although some organisations, e.g., World Bank, IMF, ILO and OECD, report data for large numbers of countries. A major problem for global databases is the fact that even if national databases are fully reconciled at the level of the nation state, they are not reconciled internationally, e.g., the bilateral values of exports of goods and services by source country and values of imports by destination country are often not 'consistent' (seeGehlhar,1996; McDonald et al., 2016). Consequently, the production of a globally 'complete and consistent' database for environmental and economic accounts requires some degree of adjustment to the reported values in national databases, with ample scope for disagreements.

53. Checking that global databases are 'complete and consistent' is difficulty. 'Consistency' can be readily verified using matrix representations of the data, but 'completeness' is problematic[7]. This suggests that the best option for evaluating global databases is 'theoretical': do the data conform to the standards defined, for example, by the SNA and SEEA? If not, there is a reason to be cautious about that global database.

V. Criteria for selection of models and methods

54. A particular challenge for Parties and stakeholders (referred to here as the 'user') undertaking assessments of the impact of the implementation of response measures lies in

[7] One exception is where a whole category or categories are omitted, e.g., remittances and aid transfers.

the process of method selection. An overarching 3-step selection process developed by this technical paper that generates a shortlist from the long list of available tools and methods is suggested:

(a) Shortlist available tools and methods using general criteria.

(b) Narrow the shortlist further using user specific criteria.

(c) Compare the detailed summaries of the shortlisted tools and methods.

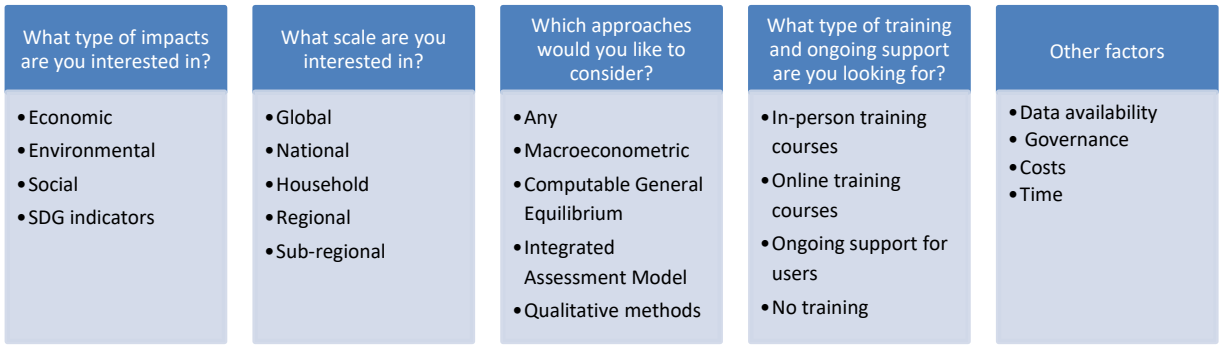
55. The outcome of the process is a shortlist of tools and methods that can be considered in detail. The first step of the selection process includes 4 general selection criteria to capture the user's context. The general selection criteria are: Types of impacts, Scale, Approach, and Training and ongoing support. Understanding any training and support needed is important as quantitative tools are often specialist approaches and complex in nature.

56. In addition to the general selection criteria, step 2 allows for a narrowing down using user specific criteria such as modelling language, type of dynamics, and internet requirements. In step 3, the detailed profiles of each tool or method in the shortlist are compared by the user and the final selection made.

57. Step 1 of the process is illustrated in **Error! Reference source not found.**. The user may select as many, or as few options, as they wish for each question (where a user has no preference, all answers should be included). The selection is not path dependent, meaning that the outcome is independent of the order of the selection questions. It is important to keep in mind that the tool or methodology selected for assessing impacts of the implementation of response measures should allow for assessing positive as well as negative impacts. In practice, the shortlisting process can take place directly, for example, in an Excel workbook[8] of tools and methods collected via the survey described in the section VII[9].

58. The user specific criteria used in step 2 depend on the preferences and constraints faced by the user including the question of whether to contract work out. The decision tree included in **Error! Reference source not found.** (adapted from UNFCCC, 2016a, p.10) also provides guidance on when to access consultancy services.

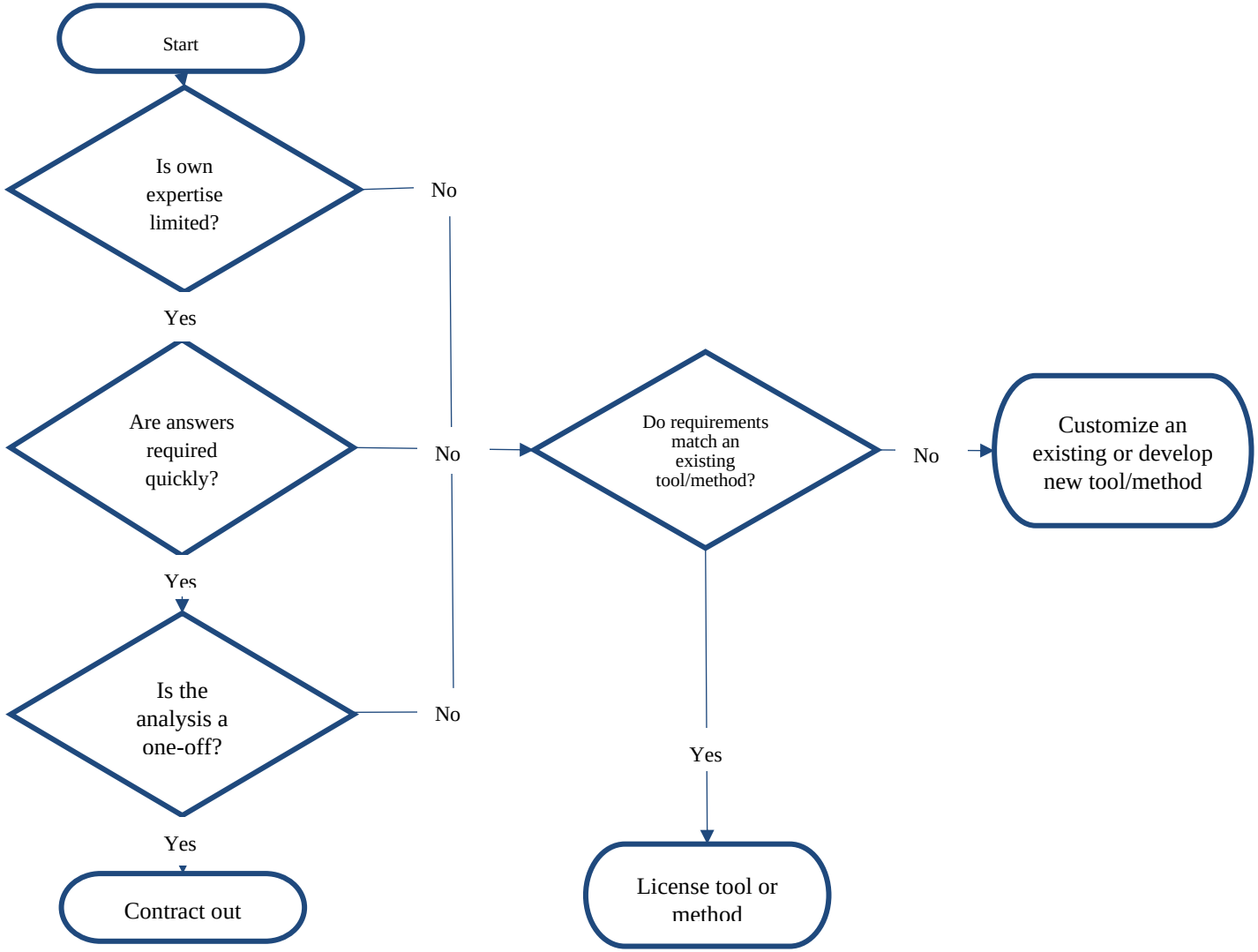
Figure 1 Non-exhaustive general criteria for shortlisting tools and methods



[8] Excel Workbook: 'Tools and methods for assessing the impact of response measures'

[9] A web-based user interface based on the survey data in the Excel workbook could be developed with an accompanying user manual

Figure 2 Decision tree for developing/customize a method vs. contracting out (adapted from UNFCCC, 2016a, p.10)



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VI. Cost effectiveness analysis

59. A review of the cost effectiveness of development, enhancement, and customization of the tools and methods that were submitted as survey responses and of use of these tools for obtaining policy insights is presented in this section. Cost-effectiveness analysis seeks to minimize the expenditures required to achieve a prespecified beneficial goal or maximise the beneficial goal for a given expenditure.

60. The application of a method for impact assessment can involve a portfolio of costs. The costs are reviewed below with further information available in the tool and methods descriptions in the Excel Workbook 'Tools and methods for assessing the impact of response measures' (see cell references).

1. Access to, and customization of, the model or method (cell C51)

61. Access to many of the models and methods is free, either for all or non-commercial users. In other cases, costs are specific to the application of the tool or method. In some cases, an academic partnership is required.

2. Access to, and management of, the data (cells C20 and C27)

62. Several of the available quantitative methods use freely available national or international (such as OECD) statistics. Global CGE models are typically based on the GTAP database which costs $2500 in low-income countries, $3740 in lower-middle income countries and $6240 in all other countries (academic pricing is lower)[10]. Contributors of regional input-output tables receive a copy of the GTAP database for free. Other sources of global data include the World Input Output Database (WIOD) which is freely available. Social Accounting Matrices for national models are sometimes freely available and sometimes incur a cost for access.

3. Access to the software (cell C53)

63. The 44 tools and methods available for impact assessment use a range of software. 11 of the tools and methods use open-source software including R, Python, Scilab, and text processing software. Four models use standard Microsoft software (Excel, Visual Basic). 18 of the 44 tools in the database use the General Algebraic Modelling System (GAMS). GAMS costs $3200 for the base module, plus $3200 each for the PATH and CONOPT solvers (plus any other solver costs)[11]. The price is for a perpetual single user license; optional Maintenance and Support costs $1920 per year. 3 further tools use the General Equilibrium Modelling PACKage (GEMPACK) which costs between $1080 and $10350 for a permanent licence[12] depending upon whether the software is used for policy analysis or model development. There is also an annual subscription option for $360-$3450. The remaining 8 tools use specialist software with prices available on application.

4. Training courses and ongoing support (cell C57)

64. Where training courses are provided, these range in costs per participant from $1000-$3000 for online courses and $2000-4000 for in person courses, with some free online content available. The costs associated with ongoing support depends upon the nature of the support required.

5. Purchase of consultancy services (cells C48 and C65)

65. The cost of consultancy services depends upon the type and amount of work requested.

66. Other context specific costs include improvements in infrastructure e.g., computing power and/or internet provision, and staff costs for time dedicated to training. Note that the

[10] https://www.gtap.agecon.purdue.edu/databases/pricing.asp
[11] https://www.gams.com/sales/pricing_regular/
[12] https://www.copsmodels.com/gpprice.htm

cost information presented in the database represented an upper limit on direct costs. Where the user already has paid access to proprietary data or software or existing in-house skills, the cost for additional activities will be lower. Previous investments and accrued knowledge may therefore steer the choice of method, particularly where there are budgetary constraints.

67. It should be noted, however, that while the costs of conducting impact assessments may be high, they are small relative to the costs of the possible negative impacts of the implementation of response measures.

VII. Database

68. An overview of the survey used to gather up to date information about available methods and a summary of the database are presented in this section. The database is compiled from survey responses completed by the authors and developers of tools and methods for impact assessment covering global, regional, and national scales. Responses were received for 44 methods[13]. Two models from the earlier database, ICLIPS and MERLIN, are no longer in use.

69. A full set of the information for each method including contact details and training provision is included in the Excel Workbook 'Tools and methods for assessing the impact of response measures' which complements this technical paper. Users are advised to confirm the specifics of a tool or method, particularly regarding Intellectual Property Rights, with the developer/owner of the tool or method.

A. Survey questionnaire

70. Authors and developers of tools and methods for impact assessment were invited to complete a questionnaire as part of the development of this technical paper. The information gathered through the survey updates and extends the existing database of tools and methods for assessing the impacts of the implementation of response measures*[14]*.

71. The involvement of the authors and developers of the tools and methods as stakeholders has a two-fold benefit. First, as tools and methods for impact assessment are constantly evolving, documentation for the methods often lags behind innovation. Collecting information via a questionnaire gathers the most up to date information about a range of quantitative and qualitative tools that are, or have the potential to be, used to assess impacts of the implementation of response measures. Secondly, involving the developers as stakeholders increases their awareness of the interest in these types of tools and methods. Activating their interest in this way supports the building of a global community in which those interested in tools for impact assessment are connected to those who construct and supply those tools.

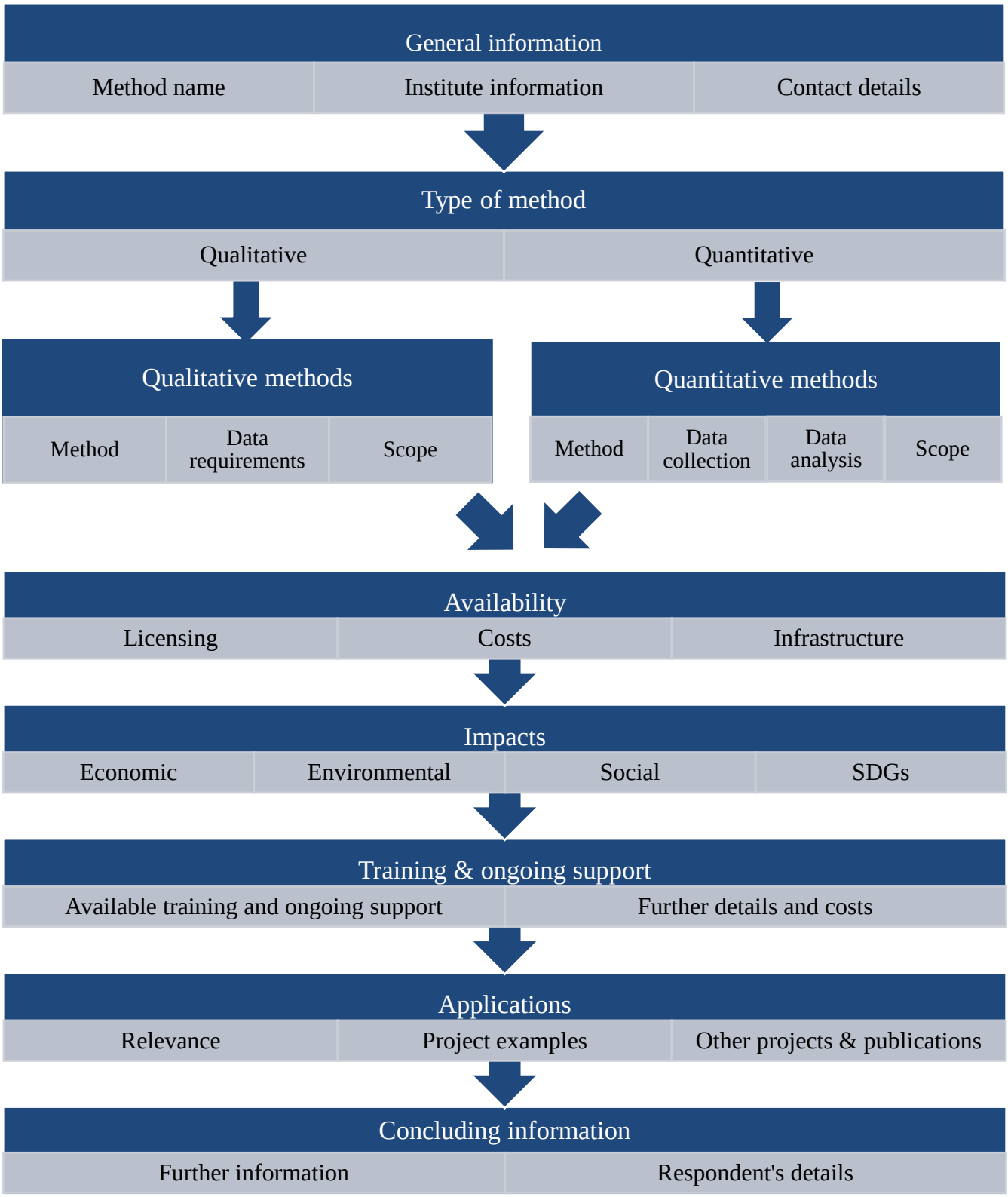
72. The online questionnaire was distributed to 88 contacts covering 94 tools and methods arising from the literature review and authors' knowledge of the field[15]. Where an institute or person maintains more than one relevant method, they were asked to complete the survey once for each method. An overview of the questionnaire is provided in Figure 3, with a full copy of the questions provided in Annex C.

[13] The database can be viewed as a place where those wanting to use tools and methods for impact assessment are brought together with those who are developing such tools. Where responses were not forthcoming despite several reminders, this was taken as a signal that they do not wish to participate in providing tools and methods for the assessment of the impact of response measures at this time.

[14] https://unfccc.int/topics/mitigation/workstreams/response-measures/modelling-tools-to-assess-the-impact-of-the-implementation-of-response-measures

[15] As there are many CGE applications, the database is focused on core models that offer the latest developments and are usually the hub for training and support.

Figure 3 Survey questionnaire overview



B. Summary of the database

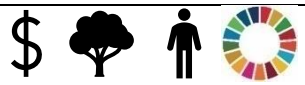
73. A summary table compiled from the database is included in Table 3. An overview of 44 tools and methods is presented using the 4 general criteria used in the first step of the selection process using the following key:

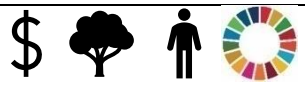
Impacts	Scale	Approach	Training & ongoing support
Economic Environmental Social SDG indicators	Global National Sub-national Household	CGE IAM Macroeconometric Qualitative Energy model	In-person courses Online courses Ongoing support

Table 2 Overview of the tools and methods in the database by selection criteria

Tool or method	Impacts	Scale	Approach	Training & ongoing support
ANARRES				
CGEBox				
CGETax				
DEMETRA				
ENGAGE				None
ENV-Linkages				None
EPPA				
GEM-E3				

Tool or method	Impacts	Scale	Approach	Training & ongoing support
GEMINI-E3				None
HMRC CGE model				
IEG-CGE				
IMACLIM-ARG				None
IMACLIM-BR				
IMACLIM-FRA				
IMACLIM-IND				
IMACLIM-SAU				None
IMACLIM-ZAF				None
MAGNET				
Multiregional CGE model of New Zealand				
MyGTAP modelling framework				None
SAGE				None
SDGSIM				
STAGE				
TEA				None
TERM				
SATIMGE				

Tool or method	Impacts	Scale	Approach	Training & ongoing support
AIM				
BLUES				None
COFFEE				None
FAIR				None
IMACLIM-R World				None
POLES				None
UKIAM				None
WITCH				None
G-Cubed				
E3ME				None
FRAMES				
GEMMES				
GINFORS-E				None
NEMESIS				None
NiGEM				
Oxford Economics Global Economic Model				

Tool or method	Impacts	Scale	Approach	Training & ongoing support
Just Transition Research Collaborative				None
Res-IRF				

74. While the survey and resulting database are global in their coverage, the tools and methods identified for national impact assessments are skewed towards developed countries: 75% of national models in the database are developed for upper-middle and high-income countries.

C. Using the database

75. The Excel Workbook that accompanies this technical paper is available for use by Parties and stakeholders to aid the selection of tools and methods for the assessment of the implementation of response measures appropriate to their situation.

76. Using the filters in the ‘General selection criteria’ part of the ‘Select tool or method here’ worksheet, narrows down the selection of available tools according to a user’s general preferences. For example, a stakeholder interested in economic and social impacts at a national scale using a CGE approach with in-person training will find that the choice of models narrows down from 44 to 5. Further user specific criteria can then be applied in step 2 using the ‘user specific criteria’ filters on the same worksheet e.g., preferences for a particular programming language, and the number of suitable methods restricted further. The final stage in step 3 is to compare the detailed descriptions of the shortlisted models provided in the linked worksheets (click on the name of the tool or method) to determine which tool or method best suits the Party or stakeholder for a particular impact assessment.

VIII. Concluding Comments and Recommendations

77. The aim of this technical paper is to lower the informational barrier faced by potential users of tools and methodologies for impact analysis. The technical paper and accompanying database provide detailed information about a range of tools and methods that are available to be developed, enhanced, customised, and used for assessing the impacts of implementation of response measures with a view to minimizing adverse impacts and maximizing positive impacts. Other tools and methodologies may also be used to model and assess impacts.

78. A wide range of tools and methods that are, or have the potential to be, used to assess the impacts of the implementation of response measures are identified and introduced including, inter alia, economic, social, environmental, domestic, cross-border, positive, and negative impacts. Up to date information about a number of tools and methods has been gathered using a survey questionnaire and collated into a database of methods which updates and extends the previous database. A suggested 3-step selection process developed by the authors is outlined to help users identify tools and methods best suited to their needs.

A. *Recommendations*

79. Based on this Technical Paper, a range of possible recommendations to facilitate to the development, enhancement, customization, and use of modelling tools, and methods for assessments and analyses of the impacts of implementation of response measures are presented in this section.

80. A broad range of tools and methods is available for assessing the impact of the implementation of response measures. A comparison of the 2016 list of tools and methods

with the update presented in this paper highlights the fast-paced development of these types of tools. New models and tools are developed, and the development of existing tools often outpaces documentation updates.

Recommendation 1: Regularly update the existing database of tools and methods, as needed and as appropriate.

81. Updating the database through interactions with the authors and developers helps ensure that Parties and stakeholders have access to the most up to date information when deciding which tool or method to use.

82. An ability to narrow down the choice of tools and methods facilitates Parties and stakeholders in identifying the type of approach that is best suited to their question and particular circumstances.

Recommendation 2: Develop and maintain a web-based user interface for selecting tools and methods and promote its use among the Parties and stakeholders, as needed and as appropriate.

83. A user manual would guide users through the process of using the interface could be developed.

84. The complex nature of many of the approaches means that training and support can be an important factor to consider when deciding upon a particular tool or method.

Recommendation 3: Consider the availability of country level expertise, training and support, and consultancy services when selecting a tool or method.

85. High quality impact analysis relies on availability and accessibility of high-quality data that can a constraining factor for countries.

Recommendation 4: Invest in data collection, if possible, then in line with national and international standards (for example, the UN System of National Accounts (SNA) or the UN System of Environmental-Economic Accounting (SEEA).

Recommendation 5: Capacity building partnerships and networks could be helpful for increasing the representation of developing countries in the use and development of impact assessment tools and methodologies.

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X. Glossary

Comparative static
A modelling mode which allows for a comparison of the state of an economy before and after a policy change.

Computable General Equilibrium (CGE)
A whole economy model based on economic theory and populated with real economic data. The models are systems of equations which represent the behaviour of firms, households, and government.

Cost-effectiveness analysis
An approach which seeks to minimize the expenditures required to achieve a prespecified beneficial goal or maximise the beneficial goal for a given expenditure.

Cross border impacts
Impacts to a domestic economy of the implementation of policies felt in other countries or groups of countries.

Domestic impacts
Impacts to the domestic economy of the implementation of within country policies.

GTAP database
A global database describing bilateral trade patterns, production, consumption and intermediate use of commodities and services (Aguiar et al., 2019).

Impact assessment
A structured process for considering the implications of proposed actions while there is still an opportunity to modify (or even, if appropriate, abandon) the proposals (*ex ante*) or after the implementation of the actions (*ex post*). It is applied at all levels of decision-making, from policies to specific projects (IAIA, 2021).

Impact of the implementation of response measures
Impacts arising from the implementation of response measures within a country, includs both domestic and cross-border impacts.

Integrated Assessment Model (IAM)
A model that integrates geophysical and economic systems.

Macroeconometric model
A large-scale model of a national economy that uses behavioural equations estimated from national accounts data.

Mixed method
An approach using both qualitative and quantitative methods.

Recursive dynamic
A modelling mode which allows for a comparison of the development an economy over time with and without a policy change.

Response measures
Responses to combat climate change in the form of policies, measures, programmes and actions.

Social Accounting Matrix (SAM)
A comprehensive, economy-wide database recording data about all transactions between economic agents in a specific economy over a specific period (Mainar Causape et al., 2018).

System of Environmental-Economic Accounting (SEEA)
The SEEA is an internationally agreed framework that integrates economic and environmental data to provide a more comprehensive and multipurpose view of the interrelationships between the economy and

the environment and the stocks and changes in stocks of environmental assets, as they bring benefits to humanity (SEEA, 2021).

System of National Accounts (SNA)
The SNA is the internationally agreed standard set of recommendations on how to compile measures of economic activity. The SNA describes a coherent, consistent, and integrated set of macroeconomic accounts in the context of a set of internationally agreed concepts, definitions, classifications, and accounting rules (UNSTATS, 2020).

Quantitative method
An approach using numerical data.

Qualitative method
An approach using non-numerical or numerically descriptive data.

Annex A

List of tools and methods

Table 3 List of tools and methods (survey entries shown in bold)

Global CGE models	National CGE models	Integrated Assessment Models	Macroeconometric models	Qualitative and mixed methods
ANARRES	CGEGEM	AIM	E3ME	JTRC
CGEBox	CGE of Asia-Pacific	BLUES	ENTICE-BR	Methodology for Country Case Studies
CGEGEM	CGE of Latin America	COFFEE	FRAMES	
ENGAGE	CGETAX	FAIR	G-CUBED	
ENVISAGE	CGE-UCL	FUND	GEMMES	
ENV-Linkages	Deloitte CGE model	IMAGE	GINFORS-E	
EPPA	DEMETRA	MERGE	NEMESIS	
GCAM	Ecomod	PANTA-RHEI	NiGEM	
GEM CCGT	HMRC CGE model	POLES	Oxford Economics Global Economic Model	
GEM-E3	IEG-CGE	Second Generation model		
GEMINI-E3	IFPRI Standard Model	TIMES IAM		
GLOBE	IMACLIM	UKIAM		
GTAP	KPMG-CGE	WITCH		
GTEM	LANL CGE			
GRACE	LSHTM CGE model			
GTAPinGAMS	Multi-Regional CGE for New Zealand			
ICES	Multi-regional CGE model for China			
IGSM	ORANI-G			
IMACLIM-R	PEP 1-1/ 1+t			
IPAC	PWC CGE model			
MAGNET	SAGE			
MESSAGE-GLOBIOM	SATIMGE			
MIRAGE	SDGSIM			
MS-MRT	STAGE			
MyGTAP	TERM			
PACE	WiNDC-based model			
PEP				
REMIND				
RHOMOLO				
TEA				

Annex B

Literature search

1. The following search terms were implemented in Scopus to cover the scientific literature, and Google to cover the grey literature, based on the definition of the impact of the implementation of response measures in section I to aid the identification of relevant tools and methods:

(a) Climate AND impact AND (Kyoto OR Paris OR Convention)

(b) (“Mitigation policies” OR “Climate policy” OR “NDCs” OR “Carbon pricing” OR “Carbon tax” OR “ETS”) AND impact

(c) (“Response measures” OR Spillover OR cross-border OR externality) AND impact AND climate AND policy

Annex C

Survey questionnaire

1. The survey questionnaire was written in and distributed using Google Forms. A copy of the full questionnaire is provided in this annex.

Tools and methods for assessing the impact of the implementation of response measures (UNFCCC)

The purpose of this questionnaire is to gather information on available quantitative and qualitative tools that are, or have the potential to be, used to assess the impact of the implementation of response measures.

The term ‘response measures’ refers to mitigation policies, programmes and actions, to combat climate change, taken by Parties under the Convention, the Kyoto Protocol and the Paris Agreement. The impact of the implementation of response measures are social, economic and environment impacts that arise from these actions e.g., changes in GDP, employment.

The information supplied will be used to create a report and update a database of available tools maintained by UNFCCC for UN Parties and other stakeholders wishing to conduct impact assessments of the implementation of response measures.

The questionnaire takes approximately 20-25 minutes to complete.

If you/your institute has more than one relevant model or qualitative method, please complete the survey once for each model.

*Required

General information

1. What is the name of the model or qualitative method? *

2. What is the name of the lead institute developing/using the model or qualitative method? *

3. What type of organisation is the above? (Select all that apply) *

Tick all that apply.

Research

Government

Consultancy

Other:

4. Who is the main contact for the model or qualitative method? *

5. What is the email address of the main contact for the model or qualitative method? *

6. Do you give permission for the contact details provided be published in publically available information? *

Mark only one oval.

Yes

No

7. Do you give permission for the contact details provided be retained for future use? *

Mark only one oval.

Yes

No

Type of method

8. Is the method qualitative or quantitative? *

Mark only one oval.

- Qualitative
- Quantitative

If Quantitative, skip to question 22

Qualitative methods

9. What best describes the method used? *

Mark only one oval.

- Grounded theory
- Ethnography
- Action research
- Interpretive phenomenological research
- Discourse analysis
- Narrative research
- Other:

10. How are the data collected? (Select all that apply) *

Tick all that apply.

- Interviews
- Questionnaires
- Focus groups
- Participant-observation
- Textual/visual analysis
- Case studies
- Stakeholder engagement
- Expert knowledge
- Delphi
- Other:

11. How are the data analysed? (Select all that apply) *

Tick all that apply.

- Coding
- Pattern thematic analysis
- Content analysis
- Other:

Qualitative method information

12. When was the method first developed? *

13. What is the scope of the method? *

Mark only one oval.

- Global
- National

Sub-national

Municipality

Household

Selected group

Other:

14. What is the geographical coverage of the method? *

15. What type of analysis is possible with the method? *

Mark only one oval.

Ex-post

Ex-ante

Both ex-post and ex-ante

Other:

16. What time period does the method cover? (If no time period, enter 'none'.) *

17. What software are required to analyse the data? (If no software needed, enter 'none'.) *

18. Who supplies the software? (If no software needed, enter 'none'.) *

19. Please enter the website for the method. (If none, please write 'none'.) *

20. Is technical documentation available for the method? (If yes, enter a web address, if no, enter 'none'.) *

21. Is a user guide available for the method? (If yes, enter a web address, if no, enter 'none'.) *

Skip to question 43

Model information

22. What term best describes the type of model? *

Mark only one oval.

Macroeconometric

CGE

IAM

Other:

23. When was the model first developed? *

24. Please provide a short description of the method. (Maximum 200 words) *

25. What is the scope of the model? *

Mark only one oval.

Global

National

Sub-national

Other:

26. What is the geographical coverage of the model? *

27. What type of dynamics are in the model? (Select all that apply) *

Tick all that apply.

Static

Recursive dynamic

Intertemporal

Error correction

Other:

28. What is the base year of the model? (If no base year, enter 'none'.) *

29. What time period does the model cover? (If no time period, enter 'none'.) *

30. What software are required to run the model? *

Mark only one oval.

EViews

GAMS

GEMPACK

OX

STATA

Other:

31. Who supplies the software? *

32. Please provide a short description of the model. (Maximum 200 words) *

33. Please enter the website for the model (If none, please write 'none'.) *

34. Is technical documentation available for the model? (If yes, enter a web address, if no, enter 'none'.) *

35. Is a user guide available for the model? (If yes, enter a web address, if no, enter 'none'.) *

Data requirements

36. What is the geographical coverage of the database? *

37. What is the core database used in the model? *

Mark only one oval.

National statistics

OECD

IMF

World Bank

GTAP

National Social Accounting Matrix

Other:

38. What is the format of the core database? *

Mark only one oval.

csv

Excel

Header Array (har) file

GAMS Data eXchange (gdx) file

Other:

39. Is the core database available for use by third parties? (If yes, enter a web address, if no, enter 'none'.) *

40. Please provide a web address for the database documentation. *

41. What other data are used in running the model?

Mark only one oval per row as Required or Optional.

Bloomberg

Emissions data

Land data

Labour data

Other (please specify below)

Bloomberg

Emissions data

Land data

Labour data

Other (please specify below)

42. Are the other data available? (If yes, enter web addresses, if no, enter 'none'.) *

Availability

43. Is the model or qualitative method available for use by third parties? *

Mark only one oval.

Yes - open source or licensed

Yes - consultancy services available

No

44. Who owns the Intellectual Property Rights to the model or qualitative method? *

45. How is the model or qualitative method licenced? *

Mark only one oval.

Freely available

Open source (please describe type of licence in the next question)

User licence

Model purchase

Other:

46. For open-source models or qualitative methods, please describe the type of licence below.

47. What is the cost of using the model or qualitative method? (Please provide link to costing information) *

48. How is the model or or qualitative method software run? *

Mark only one oval.

Locally

Server - no third-party access

Server - third party access possible

Cloud

Other:

49. Is an internet connection needed to run the model or qualitative method software? *

Mark only one oval.

Yes

No

Impacts

50. What type of economic impacts can the model or qualitative method show? (Please select all that apply) *

Tick all that apply.

- Economic growth
- Economic growth per capita
- Sectoral change
- Price changes
- Factor returns
- Employment
- Household income
- Investment
- Trade
- Government budget
- Technology change
- Exchange rate
- Real exchange rate
- None
- Other:

51. What type of environmental impacts can the model or qualitative method show? (Please select all that apply) *

Tick all that apply.

- Sustainable energy
- Fossil energy
- GHG emissions
- Domestic material consumption
- Biodiversity
- Water
- Marine life
- None
- Other:

52. What type of social impacts can the model or qualitative method show? (Please select all that apply) *

Tick all that apply.

- Income inequality
- Poverty
- Hunger
- Health
- Education
- Gender equality
- Remittances
- International aid
- None

Other:

53. How many UN Sustainable Development Goal (SDG) indicators does the model or qualitative method show impacts for? (Please select one answer per row) *

Mark only one oval per row: None, 1-3 indicators, 4-6 indicators, 7-10 indicators, 11+ indicators.

SDG1 No poverty

SDG2 Zero hunger

SDG3 Good health & well-being

SDG4 Quality education

SDG5 Gender equality

SDG6 Clean water & sanitation

SDG7 Affordable and clean energy

SDG8 Decent work & economic growth

SDG9 Industry, innovation and infrastructure

SDG10 Reduced inequalities

SDG11 Sustainable cities & communities

SDG12 Responsible consumption & production

SDG13 Climate action

SDG14 Life below water

SDG15 Life on land

SDG16 Peace, justice and strong institutions

SDG17 Partnership for the Goals

Training and support

54. What type of training and support are available? (Select all that apply) *

Tick all that apply.

Online training courses for the named model or qualitative method

In-person training courses for the named model or qualitative method

Ongoing support for users of the named model or qualitative method

None

55. Please provide link(s) to details of available training and support. (If no training, enter 'none'.) *

Applications

56. Please describe the relevance of the model or qualitative method in assessing the impact of the implementation of response measures. (Maximum 150 words.) *

57. For national CGE models only, does the model allow for exogenous changes in the following?

Mark only one oval per row: Yes, No, N/A

World prices

Exchange rate

International transfers

58. Please provide examples of project(s) using the named model or qualitative method related to climate change and response measures. (include web links where possible). (Maximum 250 words.) *

59. Please provide web links to other projects and publications using the model or qualitative method. *

Further information

60. Please use the section below for any other relevant information.

Respondent information

61. Respondent's name *

62. Respondent's email address *

63. Do you give permission for your name and email address be retained for future contact? *

Mark only one oval.

Yes

No

2. Thank you for completing the questionnaire