

THE GLOBAL STOCKTAKE

CLIMATE DATATHON

PROMPT OWNER

Climate Equity Reference Project (CERP)/
Carleton University

PROMPT TOPIC

Open, Transparent, Accessible, and Flexible
NDC Mitigation Quantification

PROMPT DATASET

Initially, the project could build upon two datasets, the CERc Core Database and the CERP NDC quantification code base, but the objective of the envisioned tool to be flexible suggests that easy interfacing with other relevant databases should be built in from the outset.

TOPIC BACKGROUND / PROBLEM STATEMENT:

The mitigation targets put forward by countries in their NDCs[i] do not currently follow a common format and different ways of expressing mitigation pledges ('target types') exist, targets are often limited to certain sectors and/or gases. Both of these aspects result in (at times substantially) different ways to quantify the emissions levels introducing a level of uncertainty that's based on researchers' assumptions. Furthermore, differences in data sources used for the quantification (historical socioeconomic and emissions data as well as projections) introduce further uncertainty. See appendix for further details on target types and data uncertainties.

As a result, NDC quantification is not a straightforward process, because (depending on the target type) different types of input data are required (e.g. historical GHG data for historical-base-year targets, GHG and GDP data for intensity targets, baseline projections for baseline-relative targets, and so on) and since for many of these required data source no commonly accepted methodology or authoritative data source exists, input assumptions have a large impact on NDC quantification.

As a result, different teams of analysts arrive at, and use different levels of NDC-implied global, regional, or national emissions levels. There are a few projects that quantify NDC emissions levels. These include the UNFCCC secretariat's synthesis report on NDCs, the UNEP gap report, PBL's Climate Pledge INDC Tool, Climate Interactive, Climate Action Tracker, Climate Equity Reference Project, and Climate Resource's NDC factsheets. Notably, though, to my knowledge only the latter two have a complete set of national NDCs that are publicly available[ii] and in all cases, input assumptions and data sources are opaque and inflexible, and assumptions and interpretations of NDC utterances are untransparent.[iii]

However, despite all this, there is an immutable core of information that is central to NDC quantification and that is the utterances made by parties in their NDC documents. In most cases, these utterances are clear enough to imply a single interpretation. However, there is not currently a source of such data (the "CERP NDC quantification code base" (see above) is an incomplete attempt to create such a data source). Based on such a data base, an "Open, Transparent, Accessible, and Flexible NDC Mitigation Quantification" tool could, based on end-users input with regards to their quantification assumptions,[iv] transparently quantify the greenhouse gas emissions levels that would result from the implementation of the NDC targets. This would allow users of such a tool (the first of which would obviously be yourselves) to not only calculate the NDC emissions levels in the countries, regions, and globally, but also investigate the uncertainty and sensitivity of these results to quantification assumptions. This would be a valuable input to the GST since it would provide specific insights in how the provision by countries of more clarity about their mitigation pledges in their NDCs could improve the collective understanding of where the implementation of these NDCs would actually get us to. Furthermore, it would allow future users of the tool to assess whether NDC quantifications (the quantification processes and therefore the results) align with their own views of a reasonable set of assumptions and would allow them to easily run the quantification themselves with their own set of assumptions and/or their own input dataset.

[i] In this note, “NDC” is taken to be synonymous to “mitigation pledge(s) contained in an NDC.” This differentiation is important since many NDCs contain information and commitments that do not relate to mitigation.

[ii] The other examples may only release globally aggregated figures (in the case of UNEP and UNFCCC; though they have national-level data “behind the scenes”) or limit their analysis to a subset of countries (Climate Action Tacker, PBL).

[iii] (Also, due to the nature of the NDC that has emerged in recent years that NDCs are ‘living documents’ that are updated fairly frequently, NDC quantification are at risk from becoming out of date fairly quickly.)

[iv] See “Opportunities and Challenges” below for an (incomplete) list of ways in which assumptions and decisions made in the quantification process impact the result of the quantification.

MAIN PROMPT CHALLENGE

The main challenge is to create a “Open, Transparent, Accessible, and Flexible NDC Mitigation Quantification” tool that, based on input data sets of relevant socio economic (GDP, population) and emissions data (disaggregated by sectors and gases)[i] and the relevant utterances about mitigation targets from countries’ NDC documents, quantifies the emissions levels that would result from the implementation of these mitigation pledges under certain (end-user) assumptions. The challenge extends to use the tool to investigate the sensitivity or uncertainty of NDC quantification results, e.g. how large is it in general, globally or in certain regions, which are the dimensions of assumptions that cause the highest degree of uncertainty, do some target types imply more uncertainty than others, etc.

SUPPLEMENTARY QUESTIONS

To maximize usefulness of the tool to the research and policy community, it is proposed that the tool be “Open, Transparent, Accessible, and Flexible.” Open (open source) and transparent ensure that end-users can fully understand how assumptions impact the NDC quantification, while open source in particular also allows them to implement their own assumptions and/or update or change the input NDC utterances if their interpretation differs from the tool’s or whenever NDCs are updated (if hosted on a collaborative open source space such as GitHub, this could also help ensure that the tool remains up-to-date as NDCs change). Flexible refers to the tool being able to easily not only take users’ quantification assumptions into account but also allows them to easily bring their own (socio economic and emissions) data sets and/or projections algorithms into the tool and quantification process. Accessible suggests that the code base of the tool be organized in a manner that’s friendly humans in general and to non-coders in particular, for example where the code base representing NDC utterances is organized to that a person with no or minimal coding experience feels confident and empowered to make their own adjustments and or updates. Accessible could also mean that the tool can run on readily available systems, perhaps including a web-hosted instance with a good user interface to assumption choices, input data sets, visualization of results and of sensitivity to alternative assumptions, data export, and so on. The sky’s the limit.

OPPORTUNITIES AND CHALLENGES WITH THE CURRENT DATA

The main challenge here is the fact that quantification of an emissions level resulting from NDC implementation does not straightforwardly follow from the utterances about a mitigation target contained in an NDC document. In particular, uncertainties are introduced when, in the context of quantification, researchers need to make choices or assumptions about, inter alia:

- Choice of historical data: different data sources exist with different historical data (socio economic, emissions). Differences exist, for example, between country-reported and third party data.[i] Differences are more pronounced in sectors other than energy and industry (especially in LULUCF), and are more pronounced for greenhouse gases other than CO₂. Data sources for socio economic data (especially GDP) can also be substantially different.
- Choice of projection data and/or projection method. Projections of (baseline) emissions levels and/or socioeconomic data are highly uncertain, with some mitigation targets relative to projected metric.
- Treatment of NDC-provided data: some countries provide their own data (especially baseline projections) in their NDCs. End-users/NDC researchers need to decide whether to prioritize this data over their own, with a potential trade off with regards to interoperability with their other data.

- Uncovered sectors/gases: where NDCs include mitigation targets only for certain sectors and/or gases (e.g. only for CO₂ from energy), end-users/researchers have to make assumptions about the other sectors to derive a national total emissions figure. For example, they could assume a similar level of mitigation action or ambition (relative to a historical base year, a baseline projection or other metric) in uncovered sectors as in covered ones, they could assume that emissions in uncovered sectors remain constant at (current, another) levels, they could assume absent a pledge to the contrary, uncovered sectors will develop along a baseline reference case (which in turn is subject to uncertainty – see above), assume global average effort for these sectors, or any number of other assumptions.
- Sectoral/gas breakdown: if researchers are interested only in mitigation in certain sectors/gases [ii] but NDCs provide targets with a larger cover (typically: economy-wide), assumptions need to be made about how the target “splits” across sectors.

[i] See Gütschow et al. (2021) for an example data set.

[ii] For example, the Climate Action Tracker (CAT) but also the Climate Equity Reference Calculator, exclude emissions from LULUCF in their analyses. See CAT’s Brazil analysis (“Assumptions” tab) for an example of the assumptions made to facilitate this exclusion.

BENEFITS AND CONTRIBUTION

Standardized-yet-flexible NDC quantification: Quantifying NDCs is a central step in assessing the ambition and fairness of mitigation pledges. Yet all current NDC quantification efforts are completely opaque in either/and their approach, interpretation of NDC utterances and input assumptions. Having a shared, and therefore standardized, NDC quantification methodology addresses this black-box problem. And, being able to base the NDC quantification on a transparent menu of input assumptions and data, the project would be attractive for a number of different research/analytical projects as it allows them to pick the input data/assumptions that apply to their project.

Lowering participation threshold: Currently, in the absence of a good, openly accessible, transparent central repository of NDC quantification information, scholars, policy analysts, advocates, or policy makers face a high threshold for engaging in NDC assessment activities. Building the infrastructure to quantify NDCs and then read and think about quantification of dozens or up to 154 NDC documents (depending on the desired coverage). Arguably, this has prevented, and will prevent, many potential participants in the debates around ambition and fairness to contribute to the conversation, whereas this project would enable their engagement by virtually eliminating this particular participation threshold.

Complete set of NDCs Many activities that are based on quantification of NDCs, only quantify the easier-to-quantify pledges of the larger economies. By providing complete coverage, this project and its existence could allow other projects that are currently not including all NDCs in their analyses to do just that.

Capturing the best collective understanding By being open-source and inviting conversations about and possible corrections of NDC quantification formulas, the project is in a position to capture the best collective understanding and agreement of analysts within the NDC assessment community without duplicating effort, thus allowing analysts to focus on other aspects of the NDC assessment work.

Facilitating transparency A central idea behind this prompt is complete transparency, understood not only by making source code and assumptions open-source but also comprehensible to the largest possible user base. This could be part of the code design approach, e.g. ensuring that “geeky” code that may alienate users with less confidence in reading computer code is moved into auxiliary files and the main end-user-facing code files are written with human readability as a paramount principle. Ideas to facilitate this include the choice of a suitable language (python?), potentially the use of Jupyter notebooks to further aid by adding visually pleasing comment text and intermediate results to the computer code, a well user-interfaced web instance could also prominently display the NDC quantification formulas to the end-user to demonstrate their readability and encourage end-users to dig into the code to scrutinize it. Further, extensive human-readable comments to the NDC quantification formulas could be used to describe and justify the interpretations of the NDC utterances, while also including the utterances in verbatim.

Clarifying the source of uncertainty By encouraging the use of a shared set of NDC quantifications, this project could facilitate clarity as to the source of uncertainty and in differences in different analysts' assessment of the NDCs. Currently, since NDC quantification occurs in various black boxes, it is impossible to tell, how much of a difference in assessments is due to input data sources/assumptions, how much is due to the NDC quantification (i.e. the interpretation of NDC utterances) and how much is due to different approaches to assessment. Using a shared set of NDC quantifications, and being able to re-run one's own analysis with another research team's input assumptions/data achieves great clarity on the source of the differences.

Future proof This is a particularly important time for a project like this. Recent years have started to demonstrate that many countries think of their NDCs as "living documents, with updates submitted to the UNFCCC fairly frequently, thus quickly rendering less flexible quantification projects out-of-date. After completion of the GST, countries will likely once again be asked to enhance and update their NDCs and resubmit them. Providing them with more clarity about the ways in which their NDC targets are subject to uncertainty and subject to interpretation help with an overall more robust set of NDCs.

APPENDIX [SEE NEXT PAGE]

Appendix

Additional Details on Data Sets

- The CERc Core Database is a database with national-level socioeconomic and emissions data, including historical data and future projections. It's available at <https://github.com/climateequityreferenceproject/cerc-coredb>
- The CERP NDC quantification code base is a proto version of a collection of python-style computation commands that represent information in NDC documents in a machine-readable manner and could be used to quantify these NDCs. It was current as of August 4, 2021¹⁰ – any NDCs submitted or update after that date are not currently up to date in the files (the prompt owner might be able to assist in updating and/or quality control of the file during the Datathon). Further, the code assumed a certain structure of the data project which teams might want to change. https://docs.google.com/document/d/1c6F2CJB3BcwQAU1Xr5o6JxVdG-_miaRxsSN-vLLi7OE

Target Types, Sectoral/Gas Coverage and Uncertainty in NDC Mitigation Quantification

The most straightforward types are pledges relative to a historical base year (e.g. “40% below 1990 levels”), which are used by all Annex I countries and some other countries (e.g. Brazil). Other straight-forward NDC are “target level” NDCs (e.g. used by South Africa) which explicitly state the emissions levels (e.g. in Mt CO₂eq) that the country pledges to not exceed in the target year.

Another common type is “intensity target,” where, in its most common form (though deviations exist), the pledge is expressed as an improvement of carbon intensity of the country’s economy, either relative to a historical base year or a future baseline case.

“Baseline-relative” targets are another common type, which express the mitigation target as a fraction of projected baseline emissions, information about which are often included in NDC but often missing.

Another way in which NDCs are vastly different are in their coverage of gases and sectors. While many NDCs, especially of Annex-I countries, are “economy-wide including land use,” i.e. covering all GHGs from all sources, many variations exist with developing countries often limiting coverage to the main GHGs, CO₂, CH₄, and N₂O, or limiting sectoral scope to emissions from fossil fuels and industry only, or perhaps including the waste sector.

Notes

- 1 “CERc” is the Climate Equity Reference Calculator, at <https://calculator.climateequityreference.org>. See also (Holz et al. 2019). The CERc will probably not actually be used to work on this prompt, the CERc core database is just offered here as a starting point as it is a complete database of the relevant time series needed for NDC quantification that’s maintained by the prompt owner. [The CERc is used to calculate what would be the fair share of a country of region of the global mitigation effort, this fair share can then be compared to the mitigation pledges in NDCs of countries (or regions).]
- 2 For example, the PRIMAP-hist historical emissions data set (Gütschow et al. 2021) that’s included in the CERc Core DB has a “country reported” emissions time series in addition to the “third party” values used in the CERc Core DB – examining the sensitivity of NDC quantification to “country reported” vs. “third party” could be an easy first use case for the NDC quantification tool.

- 3 In this note, “NDC” is taken to be synonymous to “mitigation pledge(s) contained in an NDC.” This differentiation is important since many NDCs contain information and commitments that do not relate to mitigation.
- 4 The other examples may only release globally aggregated figures (in the case of UNEP and UNFCCC; though they have national-level data “behind the scenes”) or limit their analysis to a subset of countries (Climate Action Tracker, PBL).
- 5 (Also, due to the nature of the NDC that has emerged in recent years that NDCs are ‘living documents’ that are updated fairly frequently, NDC quantification are at risk from becoming out of date fairly quickly.)
- 6 See “Opportunities and Challenges” below for an (incomplete) list of ways in which assumptions and decisions made in the quantification process impact the result of the quantification.
- 7 For both types of data, historical and projected data are required for NDC quantification. Historical data would be exogenous to the tool, projections could be either exogenous or/and created by the tool endogenously through its own projections algorithm(s). As a “starter set,” the CERc Core Database contains both historical and projection data and its database documentation includes descriptions of its own projection algorithms.
- 8 See Gütschow et al. (2021) for an example data set.
- 9 For example, the Climate Action Tracker (CAT) but also the Climate Equity Reference Calculator, exclude emissions from LULUCF in their analyses. See CAT’s Brazil analysis (“Assumptions” tab) for an example of the assumptions made to facilitate this exclusion.
- 10 The work was carried out by an intern and no quality control has been done on the work yet.

References

- Gütschow, Johannes; Annika Günther and Mika Pflüger (2021) "The PRIMAP-hist national historical emissions time series (1750-2019) v2.3.1". [doi: 10.5281/zenodo.5494497]
- Holz, Christian; Eric Kemp-Benedict; Tom Athanasiou and Sivan Kartha (2019) "The Climate Equity Reference Calculator" in *Journal of Open Source Software*, 4(35), 1273. [doi: 10.21105/joss.01273]