

# Comment

---

Supplementary information to:

## G20's US\$14-trillion economic stimulus reneges on emissions pledges

A Comment published in *Nature* **603**, 28–31 (2022)

<https://doi.org/10.1038/d41586-022-00540-6>

---

Jonas M. Nahm, Scot M. Miller & Johannes Urpelainen

---

This Supplementary information comprises:

1. Supplementary methods and description of data (including Acknowledgements)
2. Supplementary data on G20 fiscal stimulus spending and effect on emissions (see separate Excel file)

## **Supplementary Materials to**

### **G20's US\$14-trillion economic stimulus reneges on emissions pledges**

#### **Acknowledgements**

A team of researchers made this work possible --- Jacob Brunell, Santiago Cunial, Alex Haag, Daniel Mathew, Zubeyde Oysul, William Zhao, and Qihan Zhou. In addition, this work was partially funded by a Johns Hopkins University Alliance for a Healthier World's 2020 COVID-19 Launchpad Grant. Scot Miller's efforts were also partly funded by a Chen-Yu Pilot Grant from Johns Hopkins University.

#### **Materials and Methods**

##### Overview

In order to efficiently and systematically track and categorize the over 300 pieces of national-level legislation that constitute our global fiscal stimulus spending database, our team utilized Microsoft Excel to classify each policy according to several of relevant criteria including target sector, impact, and total spending toward emissions-reducing or emissions-increasing measures (see Data S1 below). In addition to the main coding sheet, the Excel workbook contains several subsidiary worksheets corresponding to:

1. Aggregated results concerning the total number of direct, indirect, short-term, long-term, and R&D pieces of legislation for each country covered in the analysis (see "GHG\_Tally"), and
2. A high-level stimulus spending breakdown displaying the total dollar value of all emissions-increasing, industry-neutral, and emissions-reducing stimulus spending measures for each country, accompanied by descriptive figures and charts (see "Country\_Totals")

The details of the COVID-19 related fiscal stimulus spending measures included in the database were sourced, where possible, directly from the text of the appropriate legislation or from government websites, white papers, press releases, or other media published by government agencies. In other cases, information pertaining to particular policies was drawn from other reliable sources such as academic papers, news reports, and other policy trackers.

We further report the anticipated greenhouse gas (GHG) impacts of stimulus measures where those impacts have been estimated by a government agency, nonprofit organization, or in an academic study.

##### Scope of the Study

The aim of this study is to analyze the global greenhouse gas emissions impacts of fiscal stimulus spending measures enacted by G20 countries in response to economic fallout caused by the COVID-19 pandemic. We specifically include stimulus measures that were passed between January 1, 2020, and December 31, 2021. We exclude from our study any policies that happened to fall into the time period of the recession but were not a direct economic recovery response to

the pandemic-induced recession. For instance, the regular European Budget cycle led to the passing of a new budget in 2020, but we exclude it since it would have passed regardless of the state of the economy at the time. By contrast, the United States CARES act was a direct response to the pandemic. Economic recovery was one of its core objectives, hence it is included here.

In cases where it was difficult to determine whether a bill was in fact a direct response to the pandemic, we relied on legislative texts, quotes from government officials, and other contextual information to make a determination. Where necessary, we include detailed notes about our decision in the last column of the spreadsheet. For example, China's New Infrastructure Initiative was technically announced as a policy initiative before the pandemic, but it was subsequently accelerated, concretized, and became one of the core economic responses to the pandemic and subsequent recession. Because it did not become a concrete policy measure until the recession and because it was subsequently discussed in state media and among government sources as a central response to the recession, we included it in the database.

In order to achieve consistency across countrywide comparisons and avoid double-counting of stimulus appropriations, our team focused only on fiscal stimulus spending bills that were enacted at the federal or national level, excluding policies that were passed by local, state, or regional governments or public agencies. The entities selected for coverage— Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom, the United States, and the European Union— were chosen because they jointly account for more than 80 percent of global greenhouse gas emissions and 85 percent of global economic activity (1). Excluded from the study were measures solely affecting monetary policy, such as government loans, bond issuances, deferrals, and other liquidity and guarantee measures. Due to the contingent nature of loans and other liquidity and guarantee measures, these instruments are difficult to trace to specific climate-related outcomes and often involve a high degree of uncertainty with regards to adoption.

### **Data S1. (separate file)**

We have included an Excel spreadsheet as a separate file that describes each of the stimulus measures in detail. Below, we describe each of the data columns included in that file.

- Country: The country in which the fiscal stimulus measure was enacted.
- Name of Policy: The name or particular identifier of the fiscal stimulus measure.
- Date of Passage: The date of passage provides the best estimate of the day, month, and year on which the legislation was formally approved by the appropriate governmental entity, based on the best publicly available information.
- Impact (Emissions reducing/Emissions increasing/Emissions neutral): The policies included in the database were classified according to their anticipated net impact on GHG emitting activities. Policies designated as emissions-reducing were those whose net effect was to reduce global GHG emissions; emissions-increasing policies were those that contributed to a net increase in GHG emitting activity; and emissions neutral policies were those that did not have a direct impact on GHG emissions or whose net impact on GHG emitting activity was indeterminate.

- Document # (If Relevant): This column is intended to facilitate the identification of specific pieces of legislation by tagging the document number or other alphanumeric identifier of each policy, as applicable.
- Currency: The total spending amount shown in the subsequent column (“Amount Total”) is reported in this currency. In this spreadsheet, we report spending amounts in the currency shown in the source material (typically the local currency) and convert the currency to USD in the “USD Conversion” column.
- Amount Total: The figures listed in this column represent the total value of each stimulus spending bill as denominated in the measure’s local currency. Measures that did not have explicit spending figures cited in the text of the legislation or in credible secondary sources, or measures that are not associated with any spending have “Not quantified” listed in this value field.
- USD Conversion: This column provides the U.S. dollar conversion of each fiscal stimulus spending measure based on exchange rates at the time the legislation was passed. The figures in this column were obtained by multiplying the values in the “amount total” column, which lists the total value of each stimulus spending bill as denominated in the measure’s local currency, by the applicable U.S.-foreign currency exchange rate as of the date the legislation was formally approved. We used the published exchange rate on the date when the measure was passed.
- % Towards emissions reducing or emissions increasing spending (estimate; "neutral" denotes climate neutral legislation; "unspecified" indicates % toward emissions reducing or emissions increasing unspecified): The percentages in this column represent our best estimate of the fraction of each stimulus measure allocated toward provisions with emissions increasing or emissions reducing impacts. The values in this column were obtained by netting provisions with green climate objectives against provisions that contributed to GHG-emitting activity, and dividing the resulting value by the total spending for each policy. Emissions-neutral policies were tagged as “neutral,” while fiscal stimulus measures whose GHG emissions impact was unclear were labeled “unspecified.”
- Total spending toward emissions reducing or increasing measures (empty cells indicate climate neutral measures or measures with unspecified allocation toward emissions reducing/increasing activities): The figures in this column estimate the total U.S. dollar value of spending allocated toward provisions with emissions increasing or emissions reducing impacts. The estimates were obtained by multiplying the USD conversion, which provides the U.S. dollar value of each fiscal stimulus spending measure based on exchange rates at the time the legislation was passed, by the percentage allocated towards emissions reducing or emissions increasing spending listed in the previous column.
- Emissions-Related Target Sector(s): The particular GHG emissions-related sector(s) toward which the fiscal stimulus measure, or subsidiary provision thereof, is targeted. The classification system is modeled after the California Air Resources Board’s (CARB) California Greenhouse Gas Inventory emissions report, which categorizes emissions of greenhouse gases and criteria pollutants by name or industrial sector (2). We specifically use CARB’s emissions categories, as opposed to IPCC’s emissions categories, because CARB’s categories focus on broad sectors of the economy, as opposed to specific

emitting processes. These categories include the following: industrial, electricity, agriculture & forestry, commercial, residential, and transportation. Policies that do not fit under any of CARB's aggregated emissions categories are designated "neutral," while measures that target more than one emissions-related sector are listed as "multiple sectors."

- Companies?: Indicates whether the fiscal stimulus is disbursed to businesses, corporations, or other private actors.
- Individuals?: Indicates whether the fiscal stimulus is disbursed to individuals.
- Start Date (expected): The date when the measure is anticipated to take effect and/or when spending will begin.
- End Date (expected): The anticipated date when the measure will expire and/or associated spending will cease.
- Sources: The source of the information associated with each spending measure.
- Last opened: The last date that the source material link was accessed by someone on the research team.
- Estimated GHG emissions reduction (not in %): The estimated GHG emissions reduction for emissions reducing ending measures. In this column, we only report values for measures where the government has made an official estimate, or an academic/non-profit study has made an emissions estimate. Cells are left blank if there is no estimate available. Cells are also left blank for all emissions-increasing and GHG-neutral spending measures.
- Units on the emissions reduction: The units of the GHG emissions numbers listed in the previous column.
- Source of the emissions information: A link to the source information where the GHG emissions reduction information was found.
- Is this legislation likely to have a direct or indirect impact on emissions? Third category for R&D measures: We estimate whether each specific measure will lead to direct and immediate GHG emissions impacts or whether the measure will lead to infrastructure or behavioral changes that will subsequently alter GHG emissions (I.e., indirect impacts). For example, we consider the construction of a wind farm a direct emissions impact because a new wind farm will directly reduce GHG emissions per kilowatt-hour of electricity produced on the electrical grid. Other examples of direct measures include measures that replace diesel buses with electric or natural gas buses, subsidies and grants to improve building energy efficiency, requirements to reduce methane emissions from oil and gas facilities, and programs that provide "cash for clunkers" to remove inefficient passenger cars from the road. Indirect measures include those that provide funding to build additional tracks for passenger rail, build new electric vehicle charging stations, and subsidies for public transit agencies that are having financial difficulty during the pandemic. These measures will undoubtedly lead to reductions in GHG emissions but often do so by supporting infrastructure that is a prerequisite for subsequent behavioral changes or subsequent changes in modes of transportation. Note that we have included a separate category in this column for research and development measures. These include measures that fund research efforts to develop better biofuels, batteries, and/or fuel cells. These research efforts do not neatly fit into the "direct" or "indirect" categories described

above and are placed into a third R&D category. Also note that we categorize both emissions-reducing and emissions-increasing spending measures in this column, though we do not categorize emissions neutral policies.

- Are the GHG impacts of this legislation likely to be short-term or long-term? Third category for R&D measures: We define short-term impacts as impacts that are likely restricted to the time period of the pandemic (i.e., during the time period when stimulus measures are necessary due to pandemic-related economic impacts). We define long-term impacts as changes in infrastructure or long-term behavioral changes that will likely impact emissions beyond the pandemic. Examples of long-term measures include the construction of renewable energy infrastructure, building energy efficiency improvements, new transportation infrastructure, and investments to fix leaky oil and gas facilities. Short-term measures include one-time grants or bailouts to keep public transit services running during the pandemic and temporary tax credits for renewable energy. Like the previous column, we have also included a separate, third category for R&D measures; many R&D measures arguably have uncertain GHG emissions impacts. We further categorize both emissions-reducing and emissions-increasing measures (but not neutral measures) in this column.
- Notes: The last column of the spreadsheet includes any relevant explanation or notes on the legislation or on the likely emissions impacts of that legislation.

Note that many fiscal stimulus measures include both emissions-reducing (or emissions-increasing) and emissions-neutral components. We split these pieces of legislation into multiple lines in the attached spreadsheet. Specifically, the first line describes the overall fiscal stimulus and subsequent lines show itemized spending for emissions-reducing, emissions-increasing, and emissions-neutral components. Below is an example from the Excel spreadsheet:

Country	Name of Policy	Date of Passage	Impact	Currency	Amount Total	USD Conversion	% Towards emissions reducing or emissions increasing spending (estimate; "neutral" denotes climate neutral legislation; "unspecified" indicates % toward Emissions reducing or Emissions increasing unspecified)	Total spending toward emissions reducing or increasing measures (empty cells indicate climate neutral measures or measures with unspecified allocation toward emissions reducing/increasing activities)
UK	Jobs Infrastructure Plan	7/8/20	Emissions reducing	GBP	8,800,000,000		34%	
UK	Jobs Infrastructure Plan	7/8/20	Emissions reducing	GBP	3,000,800,000	3,751,000,000	100%	3,751,000,000
UK	Jobs Infrastructure Plan	7/8/20	Emissions neutral	GBP	5,799,200,000	7,249,000,000	Neutral	

In this example, the first line provides an overview of the UK Jobs Infrastructure Plan, the second line details spending on emissions-reducing components, and the third line details spending on emissions-neutral components. The first line in this example is not counted toward

the overall tabulations; rather the second and third lines in this example are used for the overall country tabulations (e.g., in the tabs entitled “GHG\_Tally” and “Country\_Totals”).

## **References**

(1) Climate Watch, “Global historical emissions.” (World Resources Institute, Washington, DC, 2021). <https://www.climatewatchdata.org/ghg-emissions>

(2) California Air Resources Board. “California Greenhouse Gas Emissions for 2000 to 2018” (Tech. Rep., 2020, [https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000\\_2018/ghg\\_inventory\\_trends\\_00-18.pdf](https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2018/ghg_inventory_trends_00-18.pdf)).