Project Assignment: Decarbonization Policy for One Country

Presentations: Dec. 3, Report: Dec. 5

Introduction

This assignment will be more free-form than the lab assignments we have done earlier in the semester. For this assignment, you will build on the work you did for the bottom-up and top-down decarbonization analysis and investigate how decarbonization might play out in one specific country. You can work on your own or in a team of two or three for this assignment. You will choose one country, decide what that country's greenhouse gas emissions target should be for the year 2050, and then sketch out a plan for how that country could achieve its goal.

You and your team will give a short (five minutes per person) presentation in the final lab on Monday, December 3 and turn in a written report (one report from the whole team is acceptable) before midnight on Wednesday December 5. The report is not meant to be an exhaustive research report. I expect a length of around 5 pages of doublespaced text (or equivalently, around 3 pages singlespaced) per team member, plus appropriate figures, tables, and references.

Unlike previous assignments, you may use RMarkdown, Word, or any other word-processing mode that you wish when writing your report, but I would like to you produce PDF output (e.g., if you're writing in Word, save a copy in PDF format).

Establishing a Goal

Briefly, look at what your country has pledged to do for emissions reduction for the 2015 Paris Agreements (http://spappssecext.worldbank.org/sites/indc/Pages/INDCHome.aspx and the individual Country Briefs at < http://spappssecext.worldbank.org/sites/indc/Pages/Content_Brief.aspx>). Consider what the country is planning to do by 2030 or whichever alternative target year it specifies in its Nationally Determined Contribution and then consider how much more the country might reasonably plan to do by 2050 to make a fair contribution to reducing global greenhouse gas emissions while also taking into account the need for less-developed nations to grow their economies in order to lift people out of poverty.

For simplicity, I recommend that you focus on carbon dioxide emissions from burning fossil fuels rather than on all different kinds of greenhouse gases.

There is no right answer, and it would be possible to write a 50-page paper just on this part, but that is not what I want you to do. Rather, just present a simple overview of the issues your country faces and how you would choose a goal.

For instance, you could look back to 1965 (when the data on energy and emissions in the `kayadata` package begins) and add up the total emissions from your country and compare it to the total

emissions of the world during that period and then consider how your country's fraction of total emissions compare to your country's fraction of the total world population or the total world Gross Domestic Product (GDP).

You may want to refer to the table below, which lists emissions reductions from 2005–2050 for different parts of the world that would meet a global 36% emissions target in 2050. This table comes from the IPCC's representative concentration pathway (RCP) database and is based on the pathway called "RCP 2.6," which gives about a two-thirds probability of keeping global warming below 2° C. However, this table was produced from an economic model and does not take account of political and ethical considerations, such as fairness, so you are not obliged to choose the same goal that this table lists for your country or its region.

```
rcp_26 <- tribble(
  ~region, ~target_year, ~ref_year, ~reduction,
  "Australia/New Zealand", 2050, 2005,  0.82,
  "Canada",                2050, 2005,  0.72,
  "China",                 2050, 2005,  0.78,
  "India",                 2050, 2005,  0.73,
  "Japan",                 2050, 2005,  0.66,
  "South Korea",           2050, 2005,  0.67,
  "United States",         2050, 2005,  0.73,
  "Africa",                2050, 2005,  0.28,
  "Latin America",         2050, 2005,  0.40,
  "Middle East",           2050, 2005,  0.32,
  "Southeast Asia",        2050, 2005, -0.17,
  "Western Europe",        2050, 2005,  0.74,
  "World",                 2050, 2005,  0.36
)

rcp_26 %>% mutate(reduction = percent(reduction, 1)) %>% select(-ref_year) %>%
                  kable(digits = 0, align = c("c", "r", "r"),
                        col.names = c("Region", "Year",
                                      str_c("Reduction from ", rcp_26$ref_year[1])))
```

Region	Year	Reduction from 2005
Australia/New Zealand	2050	82%
Canada	2050	72%
China	2050	78%
India	2050	73%
Japan	2050	66%
South Korea	2050	67%
United States	2050	73%
Africa	2050	28%
Latin America	2050	40%
Middle East	2050	32%

Region	Year	Reduction from 2005
Southeast Asia	2050	-17%
Western Europe	2050	74%
World	2050	36%

Realizing the Goal

Once you have chosen a goal, you should apply the same kinds of methods that we used in the bottom-up and top-down decarbonization analyses to estimate what your conuntry's population and per-capita GDP may be in 2030 and 2050, and what the implications are for energy efficiency and the mixture of fuels that should supply its energy needs. This is a place to research the country's natural resources, current energy supply, and opportunities to decarbonize.

For instance, if your country is mountainous with many rivers, you may want to expand hydroelectricity. On the other hand, if it is relatively flat, has few rivers, or if all the major rivers already have dams and generators, then you may want to look at other sources of energy. If your country receives a lot of sunshine, you may want to emphasize solar energy. Don't forget to think about nuclear energy as well as renewables like hydroelectricity, wind, and solar.

I am not asking you to give a thorough engineering and economic assessment of the energy transition, but to give a brief overview of the major opportunities and obstacles to clean energy in your country and what you think would be the best strategy for reducing emissions.

Format

This is a lab report, not a formal research paper, so you do not need to structure it as a formal paper. My grading rubric for the written report will be:

- Thoughtful and sensible analysis of goals [30%]
- Thoughtful and sensible analysis of how to realize the goal [30%]
- Good use of the data for your country [20%]
- Organization of the report (do the parts fit together well and tell a clear story) [10%]
- Quality of writing [5%]
- Appropriate use of citations and references [5%]

You may choose to turn this in as an RMarkdown document (knitted to PDF, of course) or a Word document (saved as PDF), or any other format that you have rendered as PDF.

The key is that you explain clearly how you do your analysis. You can either use RMarkdown or you can turn in a document written with a word-processor and refer the reader to R scripts or an RMarkdown document with "supporting information" that contains the details of your calculations and quantitative analysis.

You will turn this assignment in by accepting the assignment on GitHub Classroom, cloning the repository to your own computer, saving your final products in the repository and committing and

pushing them to GitHub.

Data Sources

The `kayadata` package has data on the Kaya identity variables for 81 countries and top-down projections for 78 countries.

If you are working on a country that's not one of these, you may want to look at additional data, such as the International Energy Agency's energy and emissions analyses (these reports are extremely expensive to buy, but the Vanderbilt Library provides free online access to the World Energy Outlook reports from 1999–2017 through the ACORN library catalog and this link http://www.oecdilibrary.org/energy/worldenergyoutlook_20725302 if you are on campus. You can also get detailed data for energy in the the OECD nations at http://www.oecdilibrary.org/energy/energy/indicatorgroup/english_379b6cdcen).

The U.S. Energy Information Administration publishes detailed country profiles for a number of countries at < https://www.eia.gov/outlooks/ieo/>, with data on many individual countries at https://www.eia.gov/beta/international/ and brief country and regional analysis reports at https://www.eia.gov/beta/international/analysis.cfm

This list of data sources is not exhaustive and you should feel free to explore other sources of information, but don't feel that you have to spend hours in the library or the internet chasing down data. It is fine for this assignment to use "good enough" data or to substitute estimates if you can't find exact numbers for what you're looking for. Just be clear about how you're doing your analysis.

References

Pielke, Jr., Roger. 2010. *The Climate Fix: What Scientists and Politicians Won't Tell You About Global Warming*. New York: Basic Books.

Pielke, Roger A., Jr. 2009a. "Mamizu Climate Policy: An Evaluation of Japanese Carbon Emissions Reduction Targets." *Environmental Research Letters* 4: 044001.

———. 2009b. "The British Climate Change Act: A Critical Evaluation and Proposed Alternative Approach." *Environmental Research Letters* 4: 024010.

———. 2011. "An Evaluation of the Targets and Timetables of Proposed Australian Emissions Reduction Policies." *Environmental Science & Policy* 14: 20–27.