





THE ROAD TO PARIS AND BEYOND

Comparing Emissions Mitigation Efforts

*As countries announce pledges to reduce greenhouse gas emissions in the lead-up to the UN climate change conference this December, **Joseph E. Aldy** and **William A. Pizer** explore which metrics are most appropriate to compare countries' efforts.*

This year, countries will pledge to reduce their greenhouse gas emissions as part of the negotiations leading up to the UN climate change talks in Paris in December. These pledges will take on many different forms: targets as a percentage of year 1990 or 2005 emissions, percentage improvements in the ratio of carbon dioxide emissions to GDP, percentage abatement versus a “no-policy” reference case, renewable power goals, energy efficiency goals, afforestation goals, and more. Understanding the comparability of the pledged mitigation efforts will play a critical role in the negotiating process.

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Such understanding is essential to build confidence among countries and to have a common interpretation of how pledges expressed in different forms stack up against one another. Similar efforts among similar countries would likely be seen as a “fair” deal, likely a necessary condition for broad participation now and increased ambition in the future. In addition, comparable costs of mitigation efforts across countries could represent a relatively cost-effective agreement and help level the playing field internationally for energy-intensive industries.

Comparing efforts requires metrics. Yet official agreement on specific metrics and a comprehensive policy surveillance mechanism is a tall order. To help inform the difficult task ahead, we have developed a set of three basic design principles and illustrate how an array of metrics might satisfy them. Because no single metric does well in meeting all the principles, we recommend

a portfolio approach that assesses countries’ estimated emissions levels, emissions abatement, carbon and energy price effects, and costs of implementation.

Principles for Choosing Comparability Metrics

We identified three principles to help pinpoint which metrics to use in comparing nations’ mitigation efforts.

1. Comprehensive. First, an ideal metric would be comprehensive, characterizing the entire effort actively undertaken by a country to achieve its mitigation commitment. Such a metric would clearly reflect

all climate-related policies and measures—and exclude non-policy drivers of climate outcomes. It should take on similar values for countries undertaking similar mitigation efforts.

2. Measurable and replicable. Second, a metric should be measurable and replicable. The ability to replicate a given metric without subjective assumptions, using available public information, enhances the credibility of review. An emphasis on observable characteristics of effort—such as emissions levels, energy and carbon prices, and/or the use of particular zero-carbon technologies—also creates an incentive for countries to undertake actions that can be measured this way. This further facilitates transparency.

3. Universal. Third, metrics should be universal. Given the global nature of the climate change challenge, metrics should be constructed for and applicable to as broad a set of countries as possible.



US President Barack Obama meets with leaders of Brazil, China, India, South Africa, and other nations during the climate summit in Copenhagen in December 2009.

In practice, there will be trade-offs among principles in identifying and constructing metrics. For example, changes in emissions levels over time may be measurable and universally available in all countries, but this measure may not comprehensively represent mitigation effort. Mitigation cost may be a more comprehensive measure of effort but is not easily measured.

Comparability Metrics: Emissions, Prices, and Costs

Mitigation efforts can be measured many different ways, and the nations of the world are far from agreeing on a single way to do so. But the strengths and weaknesses of popular metrics begin to emerge when we examine how they stack up against our basic principles. These metrics fall into three general categories: those that focus on emissions, prices, and costs. Emissions (and other physical measures) are typically the outcomes that matter for the environment. Energy prices reflect the economic incentives to reduce emissions and energy use. Carbon prices and energy taxes reflect the particular incentives created by govern-

ment policies. Cost metrics measure useful economic resources diverted away from current consumption and non-climate investment and toward abatement.

1. Emissions. An early comparability metric was emissions relative to 1990 levels, as specified in the Kyoto Protocol (see the box on page 22). More recently, the United States, Japan, and a handful of other countries have focused on emissions relative to 2005 levels. Ultimately, choices among such metrics come down to each country's interest in achieving a more favorable baseline. Changes in emissions over time may have nothing to do with effort. One popular approach to dealing with the particular influence of economic activity is to focus on emissions intensity, or tons of carbon dioxide emissions per GDP. Prior to the 2009 Copenhagen talks, China and India each proposed emissions goals structured as percentage reductions in the ratio of emissions to GDP. Such metrics can ensure that a country is neither penalized as a climate laggard simply because of faster economic growth nor rewarded simply because of economic decline.

Comparable Effort in International Climate Negotiations

The concept of comparable effort has evolved over the past several decades in international climate change negotiations. The 1992 UN Framework Convention on Climate Change and the 1997 Kyoto Protocol set emissions targets for developed countries and established the first and most enduring notion of comparability: emissions relative to a 1990 base year. By defining quantitative emissions limits this way, particularly in the Kyoto Protocol, negotiators effectively defined effort as the percentage reductions in emissions relative to 1990. This turned out to be a simplistic and potentially misleading approach that fails to distinguish between intentional reductions and those achieved by chance. For example, Russia's emissions have remained well below 1990 levels since the Kyoto agreement due to the state of its economy, not a broad and effective emissions mitigation program.

The term “comparability of effort” first emerged explicitly in the text of the 2007 Bali Action Plan, which noted that the concept should guide consideration of developed countries' emissions mitigation efforts. Then, at the 2009 UN climate talks in Copenhagen, the European Union and Japan each announced a willingness to implement more ambitious domestic emissions targets if other developed countries committed to “comparable” reductions. But different countries held different perspectives on how to measure and compare effort—and whether to also include the pledges by the fast-growing emerging economies, such as China and India. To promote the transparency of these mitigation pledges and facilitate a better understanding of effort, the Copenhagen Accord and the 2010 Cancun Agreements called for “international consultations and analysis” and “measurement, reporting, and verification”—review mechanisms comprising reporting, technical analysis, and a period of consultation with other parties.

The emerging international climate architecture reflected in decisions at the 2014 Lima climate talks further advanced the concept of pledge and review, building on the Copenhagen model. A number of countries, including the United States, have already tabled their mitigation pledges, referred to as “intended nationally determined contributions” (INDCs) in the negotiations, and more are expected to do so over the course of this year. The Lima Call for Climate Action notes that, through this pledge process, countries may submit additional information, including data, analysis, methods, and descriptions of implementation policies that may promote the transparency and credibility of countries' INDCs.

This evolution illustrates how economics can inform the implementation of the concept of comparability of mitigation effort. In the 2009 Copenhagen Accord and in what is expected for Paris, countries' emissions mitigation pledges take on different forms. A negotiator can no longer do a simple accounting like the one required in the 1997 Kyoto talks. Instead, economic data and analysis will be necessary to determine the credibility of countries' pledges.

Table 1. Metrics and Principles for Comparing Emissions Mitigation Effort

| METRIC | PRINCIPLE | | |
|--------------------------------|---|--|--|
| | Comprehensive | Measurable and replicable | Universal |
| Emissions levels | No; a poor estimate of effort because it conflates natural trends | Yes; public domain data for energy and fossil carbon dioxide available | Yes for fossil carbon dioxide data, which exist for all countries; additional work needed for all greenhouse gases |
| Emissions intensities | Better than emissions levels, as it controls for economic trends, but a noisy signal | Yes; public domain data for energy and fossil carbon dioxide available | Yes for fossil carbon dioxide; additional work needed for all greenhouse gases |
| Emissions abatement | Yes; most comprehensive among emissions-related metrics | Challenging; requires modeling tools/subjective choices to determine counterfactuals | No; few modeling platforms evaluate more than 10 countries |
| Carbon prices | No; captures effort per ton, but says little about the quantity of tons or aggregate effort | Explicit, yes; implicit requires detailed analyses | No, given few explicit carbon pricing policies; modeling tools necessary for implicit carbon prices |
| Energy prices and taxes | No; inadequate for non-energy emissions; fails to account for non-market regulatory instruments | Yes, but unclear how to aggregate | Yes, but requires more detailed data collection than currently in public domain |
| Abatement costs | Yes; best measure of effort | Challenging; requires modeling tools/subjective choices to determine counterfactuals and model costs | No; few modeling platforms evaluate more than 10 countries |

Unfortunately, emissions intensity as a measure of mitigation effort is confounded by several issues. Growing countries tend to experience a decline in emissions intensity, owing to technology improvements and changing economic structures rather than deliberate mitigation effort. It is difficult to know what level of intensity improvement represents effort versus growth effects. Also, faster growing countries typically experience a faster decline. This makes it difficult to compare countries growing at different rates. It also means that countries growing faster or slower than expected will find it easier or harder, respectively, to meet a

target. One could instead compare levels of emissions intensity, rather than trends, but this involves the problematic conversion of local currencies into a single currency.

In recent years, regulators in some developing countries have become more interested in emissions goals specified as percentage reductions from a forecast level in a future year. Although it is more comprehensive than other emissions metrics in theory, calculating emissions forecasts in practice requires subjective judgments. If the government setting the goal also makes the forecast, it has an obvious incentive to project a high forecast in order to make the

target seem more ambitious than it is. Even if the forecast is unbiased, comparing a goal with forecast emissions is only more comprehensive in a prospective analysis. Retrospectively, comparing observed emissions with a forecast can still confuse mitigation effort with other non-mitigation events that affect emissions. A comprehensive retrospective metric would compare observed emissions with an analysis of emissions that would have occurred absent mitigation policies.

2. *Prices*. An observed carbon price bears a direct connection to effort, as it

of policies. Such implicit prices have the advantage of potentially being applied to a broader set of policies but the disadvantage of not being directly observed. Instead, they are produced by model simulations. Implicit prices also do not reflect actual impacts on energy prices, which are often the focus of those concerned about economic competitiveness.

This leads us to consider energy directly. Energy prices are transparent and measurable with high frequency. Energy prices permit a net assessment of all price-based

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measures the economic incentive to reduce emissions created by a country's mitigation policies. It also reflects marginal cost. Comparing carbon prices across countries measures the degree to which a country is undertaking more or less expensive per-ton mitigation efforts. Because countries implement domestic carbon taxes and tradable permit markets in their local currencies, comparisons will require the use of currency exchange rates—and raise questions about appropriate conversions, similar to comparisons of emissions intensity. Moreover, carbon prices will not reflect mitigation efforts associated with non-price policies—such as efficiency standards and renewable mandates—and most carbon prices are not applied to all of a country's emissions. A country also may undermine the effectiveness of the carbon price by adjusting taxes downward for firms covered by the carbon price, through so-called fiscal cushioning.

Alternatively, one could consider implicit (or “effective”) carbon prices that estimate the average cost of abatement associated with a specific climate policy or collection

policies (including carbon pricing) and thus can mitigate concerns that a country engages in fiscal cushioning and speak directly to competitiveness concerns. But this would again fail to capture effects from non-price regulations and be a poor measure of effort for countries with significant non-price policies, including the United States.

3. *Costs*. Ultimately, concern about the costs of combating climate change represents one of the most—if not the most—significant impediments to serious action by countries around the world. Costs also are closely aligned with most economists' notion of effort. A metric to compare effort based on costs—expressed as a share of national income or per capita—could examine whether comparable countries bear comparable costs from their actions. A metric based on the cost of actual policies would have the potential disadvantage of rewarding costly but ineffective policies. A complementary metric could examine the cost of achieving the same emissions outcome but using the least-costly policy. This would highlight the potential advan-

tages of some policies (that reduce more emissions with lower mitigation costs) over others. Estimating costs, however, requires economic assumptions and detailed modeling frameworks for evaluating economic changes in specific sectors and national economies.

A Portfolio Approach

No single metric scores well against all the principles. Those that are easily measured—emissions levels and intensity compared to historic levels—do not discriminate between effort and happenstance. Prices provide an observable snapshot for certain policies but not others. Emissions abatement and abatement costs probably best represent effort but require subjective assumptions and modeling to estimate. Credible differences in opinion over assumptions will produce different results, complicating any comparison and reducing confidence. The necessary modeling tools are also quite limited outside the largest developed and developing countries.

With this in mind, we recommend a portfolio of metrics. Such an approach would mirror how analysts describe the health of the macroeconomy with a suite of economic statistics that includes GDP, the unemployment rate, the inflation rate, and interest rates.

Reviewing Pledges on the Road to Paris and Beyond

Analyses that compare climate change pledges and actions across countries are increasingly relevant as we transition to unilateral pledges of domestic action and policy within international negotiations. The emerging architecture calls for countries to state what they intend to do, form views about the adequacy of each other's efforts, and react accordingly as they implement policies and make further pledges in the future.

No single metric comprehensively measures effort, is easily measured, and is universally available for all countries. Moreover, each country will prefer measures that improve its appearance. This makes it unlikely that an official metric will emerge. Instead, countries will advertise and utilize the metrics they prefer. Analysis is necessary to translate among metrics, particularly those that are harder to measure.

Compiling data and conducting this analysis of metrics will require a serious, transparent, and legitimate process. Although an official surveillance process may be years away, independent researchers can fill the gap. An array of metrics could be developed alongside data collected by existing international organizations to facilitate comparisons. Unofficial but independent expert analysis could further synthesize these data to estimate metrics that require forecasts and modeling. In turn, stakeholders and other users could provide feedback on the feasibility, integrity, and precision of available metrics and estimates. This would enable further refinement and improved estimates going forward. Given that Paris is just the beginning of an ongoing process of policy commitments, these refinements and improvements can ultimately feed into greater confidence and stronger ambition among all countries. ●

FURTHER READING

- Aldy, Joseph E. 2014. The Crucial Role of Policy Surveillance in International Climate Policy. *Climatic Change* 126(3–4): 279–292.
- Aldy, Joseph E., and William A. Pizer. 2014. Comparability of Effort in International Climate Policy. Discussion paper 14-62. Cambridge, MA: Harvard Project on Climate Agreements.
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