12 Comparing emission mitigation pledges: Metrics and institutions

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A key element in the emerging international architecture will be practical mechanisms to compare domestic efforts to mitigate global climate change. How do countries decide whether and to what degree pledges by their peers – often expressed in different forms that stymie obvious apples-to-apples comparison – are sufficient to justify their own actions now and more ambitious actions in the future? We describe a number of desirable features of metrics that might be used for ex ante comparisons of proposed pledges and ex post assessments of subsequent actions delivering on those pledges. Such metrics should be comprehensive, measurable, and universal. In practice, however, no single metric has all these features. We suggest using a collection of metrics to characterise and compare mitigation efforts, akin to employing a suite of economic statistics to illustrate the health of the macroeconomy. We illustrate the application of a suite of metrics to several countries' mitigation pledges (their intended nationally determined contributions in the UN climate talks). In the pledge and review model emerging in the climate change negotiations, participation, compliance, and ambition can be enhanced if this collection of metrics can illustrate comparable actions among peers, both prospectively and retrospectively. The latter, in particular, highlights the need for a well-functioning policy surveillance regime.

1 Introduction

Countries will pledge to mitigate their greenhouse gas emissions as part of the negotiations leading up to the Paris climate change talks in December 2015. These pledges will take on many different forms: targets versus 1990 or 2005 base year emissions, percentage improvements in the ratio of carbon dioxide to GDP, percentage

abatement versus a 'no-policy' reference (or 'business-as-usual') 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.

Why? To build confidence among countries, there will need to be a common understanding 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 countries both to live up to their pledges now and to increase ambition in the future (Ostrom 1998, Barrett 2003, Cazorla and Toman 2003). Comparable mitigation effort costs across countries also could represent a relatively cost-effective agreement and help level the playing field internationally for energy-intensive industries (e.g. Aldy et al. 2010). This interest in comparability of effort is emerging in domestic politics, both from environmental advocates who believe that such assessments can enable a ratcheting up of ambition as well as business leaders concerned about the potential adverse competitiveness impacts of climate change policy.

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 emission levels, emission abatement, carbon and energy price effects, and costs of implementation.

It is worth noting that we emphasise the role of metrics as a *facilitative* mechanism. Metrics are presented without any attempt to emphasise what countries *should* do. A clean, non-judgemental presentation of information, we believe, will encourage and facilitate reciprocity and stronger action. In contrast, a long literature across an array of disciplines has attempted to prescribe what countries should do based on ethical principles and a long-term objective (e.g. Groenenberg et al. 2004, Michaelowa et al. 2005, den Elzen et al. 2006, Höhne et al. 2006, Gupta 2007, Hof and den Elzen 2010, Bosetti and Frankel 2012).

2 History of comparability 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 emission targets for developed countries and established the first and most enduring notion of comparability: emissions levels 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 purposeful reductions and those achieved by chance. For example, Russia's emissions have remained well below 1990 levels since the Kyoto Conference due to the state of its economy, not a broad and effective emission mitigation programme.

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' emission mitigation efforts. At the 2009 Copenhagen Conference, the EU and Japan each announced domestic emission targets that included an unconditional pledge plus a further, more ambitious component conditioned on whether other developed countries committed to 'comparable' reductions. At the same time, there was no concrete definition of what 'comparable' meant to the EU and Japan. Moreover, different countries undoubtedly 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 comprised of reporting, technical analysis, and a period of consultation with other parties (see Wiener 2015 for further discussion of measurement, reporting, and verification).

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 US, the EU, and Russia – tabled their mitigation pledges, referred to as 'Intended Nationally Determined

Contributions' (INDCs) in the negotiations, by the initial 31 March 2015 deadline, and more are expected to do so over the course of 2015. Through this pledge process, the Lima Call for Climate Action notes that 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 comparability of mitigation efforts concept. In the 2009 Copenhagen Accord and in what is expected for Paris, countries' emission 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.

3 Principles for choosing comparability metrics

We identify three principles to help inform the selection of metrics to use in comparing nations' mitigation efforts (see also Aldy and Pizer 2015).

- **Comprehensiveness**. An ideal metric should be comprehensive, characterising 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.
- **Measurability and replicability**. 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, energy and carbon prices, and/or 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.
- **Universality**. 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.

In practice, there will be tradeoffs among principles in identifying and constructing the metrics. For example, changes in emission 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.

4 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. Prices on carbon and energy taxes reflect the economic incentives created by government policies to reduce emissions and energy use. Cost metrics measure useful economic resources diverted away from current consumption and non-climate investment and toward abatement.

4.1 Emissions and related metrics

We noted that an early comparability metric was emissions relative to 1990 levels, as specified in the Kyoto Protocol. More recently, countries including the US and Japan have focused on emissions relative to 2005 levels. Ultimately, choices like this come down to each country's interest in achieving a more favourable baseline. And, as we saw in the Russian example, 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 emission intensity, or tonnes of CO_2 per GDP. Prior to the 2009 Copenhagen talks, China and India each proposed emission goals structured as percentage reductions in the ratio of emissions to GDP (as did the Bush administration in 2001). Such metrics can ensure that a country is not penalised as a climate laggard simply because of faster economic growth, nor is it rewarded simply because of economic decline.

Unfortunately, emissions intensity as a measure of mitigation effort is confounded by several issues. Growing countries tend to experience a decline in emission intensity owing to technology improvements and changing economic structures rather than purposeful 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 (Aldy 2004, Newell and Pizer 2008). 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 emission 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 emission goals specified as percentage reductions from a forecast level in a future year. While more comprehensive than other emission metrics in theory, in practice, calculating the emission forecasts requires subjective judgements. If the forecast comes from the government setting the goal, there is an obvious incentive to make the forecast high in order to make the target seem more ambitious than it truly is. Even if the forecast is unbiased, comparing a goal to forecast emissions is only more comprehensive in a *prospective* analysis. Retrospectively, comparing observed emissions to a forecast can still confuse mitigation effort with other non-mitigation events that affect emissions. A comprehensive retrospective metric would compare observed emissions to an analysis of what emissions would have been absent mitigation policies; in essence, a retrospective forecast.

4.2 Carbon and energy prices

An observed carbon price bears a direct connection to effort, as it 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-tonne mitigation efforts. Since countries implement domestic carbon taxes and tradable permit markets in their local currencies, comparisons will require the use of (and raise questions of the appropriate) currency exchange rates (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 downwards 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 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 is often the focus of those concerned about economic competitiveness as well as a necessary incentive for improving end-use energy efficiency.

This leads us to consider energy prices directly. Energy prices are transparent and measurable with high frequency. Energy prices permit a net assessment of all price-based policies (including carbon pricing) and thus can mitigate concerns that a country is engaging in fiscal cushioning and speak directly to competitiveness concerns and incentives for end-use efficiency. 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 US (see Burtraw 2015 for further discussion of US greenhouse gas regulations).

4.3 Economic 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 are also closely aligned with most economists' notions 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 emission outcome but using the least

costly policy (see McKibbin et al. 2011 for an illustration of this approach). This would highlight the potential advantages of some policies (that reduce more emissions with lower mitigation costs) over others. Estimating costs, however, requires economic assumptions and detailed modelling frameworks for evaluating economic changes in specific sectors and national economies.

4.4 Synthesis of metrics

No single metric scores well against all the principles. Table 1 illustrates the challenges for each type of metric in satisfying our three design principles. Those 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. Emission abatement and abatement costs probably best represent effort but require subjective assumptions and modelling to estimate. Credible differences in opinion over assumptions will produce different results, complicating any comparison and potentially undermining confidence in the transparency and review regime. The necessary modelling tools are also quite limited outside of the largest developed and developing countries.

With these considerations in mind, it is easy to see why we recommend a portfolio of metrics, and why considerable work remains to construct the more comprehensive measures of abatement and cost. 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.

Table 1 Synthesis of principles and metrics for comparability of effort

	Principle		
Metric	Comprehensive	Measurable and replicable	Universal
Emission levels	No – a poor estimate of effort because it conflates natural trends	Yes – public domain data for energy and fossil CO_2 available	Yes for fossil CO_2 data, which exist for all countries; additional work needed for all GHGs
Emission intensities	Better than emission levels as it controls for economic trends, but a noisy signal	Yes – public domain data for energy and fossil CO_2 available	Yes for fossil CO_2/GDP; additional work needed for GHG/GDP
Emission abatement	Yes – most comprehensive among emission-related metrics	Challenging – requires modelling tools / subjective choices to determine counterfactuals	No – few modelling platforms evaluate more than 10 countries
Carbon prices	No – captures effort per tonne, but says little about quantity of tonnes or aggregate effort	Explicit – yes; implicit – requires detailed analyses	No, given few explicit CO_2 pricing policies; modelling tools necessary for implicit CO2 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 modelling tools/subjective choices to determine counterfactuals and to model costs	No – few modelling platforms to comprehensively evaluate more than 10 countries

5 The review of 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 to emphasise measures that improve their own appearance. This makes it unlikely that an official metric will emerge. Instead, countries will advertise and utilise the metrics they prefer. Analysis is necessary to translate among metrics, particularly harder to measure metrics.

Compiling data and conducting this analysis of metrics will require a serious, transparent, and legitimate process (Aldy and Stavins 2012, Aldy 2014). In his contribution to this eBook, Wiener (2015) emphasises how provisions for such a process could be addressed in the UNFCCC negotiations. Whether or not such an official surveillance process emerges in Paris or thereafter, independent researchers can fill the gap in the meantime. An array of easily available metrics could be developed and data collected by existing international organisations to facilitate comparisons.

For example, we have drawn from the data the US (US Department of State 2014a,b) and the EU (European Union 2014a,b) recently published in their initial biennial reports to illustrate a set of metrics for their respective nationally determined contributions (Table 2). An initial assessment of comparability of effort could draw from these biennial reports, with a few caveats. First, independent assessments of the 'business as usual' (BAU) forecasts in the biennial reports would enhance the credibility of claims of emission reductions relative to BAU. Second, modelling is also required to estimate future prices and costs (for an example, see Aldy et al. 2015). Third, only a small set of developing countries have submitted biennial reports to date, requiring the use of other data sources and analyses for assessing and comparing the mitigation effort represented by their INDCs. A rigorous comparability of effort exercise would draw from multiple data sources and analyses conducted by a set of independent experts (Aldy 2014, Aldy and Pizer 2015).

Table 2 Metrics for the EU and US Intended Nationally Determined Contributions

	United States[1]	European Union[2]
Announced target	-26 to -28% relative to 2005 in 2025	-40% relative to 1990 in 2030
GHG emissions		
Target in tonnes ($MMTCO_2e$)	5252	3364
Relative to 1990 (%)	-17	-40
Relative to 2005 (%)	-27	-35
Relative to 2025 BAU (%)	-25	-9
Relative to 2030 BAU (%)	-25	-25
GHG/GDP[2]		
2015 $kgCO_2e$/US$ (2005)	0.45	0.35
Target 2025	0.28	0.25
Target 2030	0.25	0.20
Δ(GHG/GDP)		
2015-2025 (%/year)	-4.9	-3.4
2015-2030 (%/year)	-4.1	-3.7
Electricity price 2025	(requires modelling)	(requires modelling)
Gasoline/diesel fuel price 2025	(requires modelling)	(requires modelling)
Natural gas price 2025	(requires modelling)	(requires modelling)
Marginal abatement costs (US/tCO_2e$)	(requires modelling)	(requires modelling)
Mitigation costs per GDP (%)	(requires modelling)	(requires modelling)

Notes: To simplify presentation, we assume a -27% target in calculating US measures. The EU 2025 measures are based on a linear interpolation between the EU's 2020 target (-20%) and its 2030 target. EU GDP estimates are converted from 2005 euros to 2005 US dollars using the OECD's 2005 purchasing power at parity exchange rate of 0.857 euros/dollar (http://stats.oecd.org/Index.aspx?DataSetCode=PPPGDP). All other data used to construct the metrics are drawn from the first biennial reports by the EU and US to the UNFCCC (EU 2014a, 2014b; US 2014a, 2014b). Note reductions relative to forecasts use 'with existing measures' forecasts for both countries (Table 6(a) in the Common Tabular Format of the biennial reports).

Unofficial but independent expert analysis could further synthesise these data to estimate metrics that require forecasts and modelling. In turn, stakeholders and other users could provide feedback on the feasibility, integrity, and precision of available metrics and estimates. This enables further refinement and improved estimates going forward. In addition, the work on developing metrics for ex ante comparisons of effort

can inform the data collection and analysis needs for ex post reviews. The retrospective review of pledges will be more informative and more effective if countries plan in advance for such reviews by implementing data collection and dissemination protocols. 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.

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