POST-2012 CLIMATE POLICY

Comparability of Developed Country Mitigation Efforts

The "comparability" of climate mitigation efforts undertaken by developed countries can be assessed in many different ways. Some relevant factors such as emissions, population, and GDP are readily quantified and compared; others, such as a country's geography, economic structure, or trade profile, are not. Given the multiplicity of factors at play, parties are unlikely to agree on an explicit formula to determine, or to assess the comparability of, their respective efforts. Rather, efforts are likely to be agreed through political bargaining in which countries emphasize the metrics and national circumstances that most favor their positions. The outcome will likely rest on parties' mutual assessments of one another's efforts, employing the criteria they deem most relevant.

Introduction

In framing the current round of climate change negotiations under the U.N. Framework Convention on Climate Change (UNFCCC), the Bali Action Plan calls for "ensuring the comparability of efforts" among developed countries.[1] Specifically, it states that an "agreed outcome" should include:

> *Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives, by all developed country Parties, while ensuring the* ***comparability of efforts*** *among them, taking into account differences in their national circumstances...*

A host of factors bear on the question of comparability of effort. Some, such as emissions, population and GDP, are more readily quantifiable. Considered side by side in various combinations, these factors produce a range of metrics that may be used to compare efforts across countries. Other important factors relevant to comparability—such as climate, geography, resource base, economic structure, trade profile and other "national circumstances"—are more difficult to quantify and, hence, to compare.

This policy brief identifies an array of relevant factors and illustrates how some of them speak to the question of comparability of developed country efforts. "Effort" is understood here as the mitigation effort required under an absolute economy-wide emissions target (although supplemental policies and measures or a party's financial contribution under an agreement might also be considered important elements of its overall effort). The brief examines in particular alternative time horizons for calculating emission targets and alternative measures of mitigation cost. (Note: Specific figures are presented for illustrative purposes only and are not intended as recommendations or proposals.)

Elements of Comparability

Efforts to assess comparability often rely on a handful of quantifiable factors that can be combined any number of ways to produce a potpourri of metrics, each offering a different slant on the issue (see **Figure 1**). The central factor is greenhouse gas (GHG) emissions, which, in the simplest of metrics, is set against a second factor such as population, gross domestic product (GDP), or mitigation cost. In more complex metrics, multiple factors are considered simultaneously—for instance, mitigation costs per capita or per GDP at a given level

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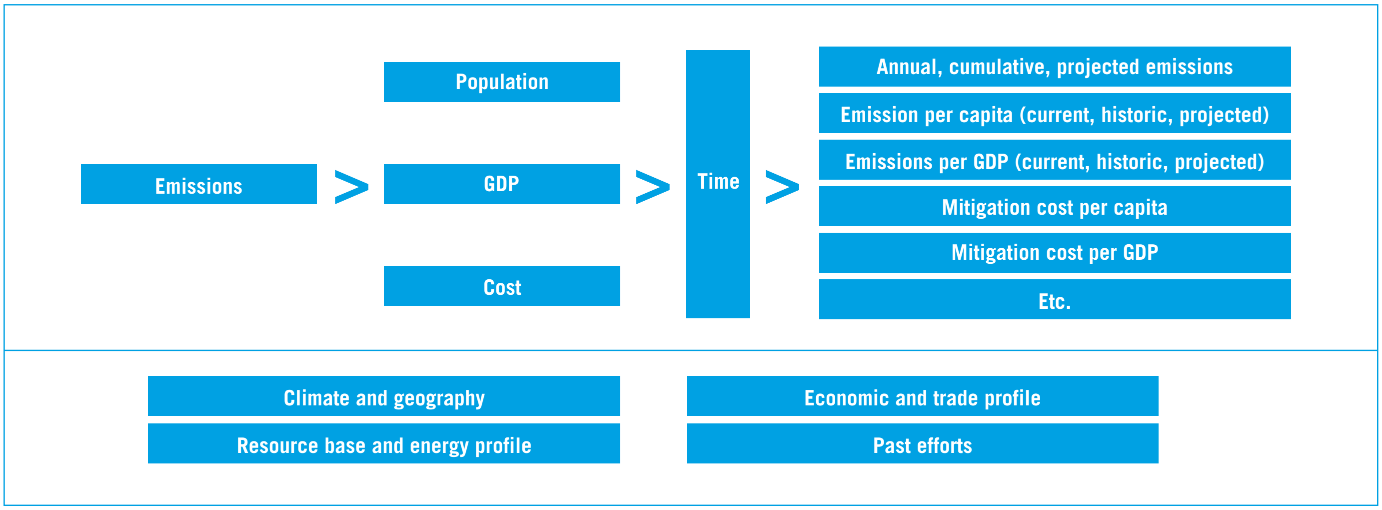
Figure 1. Factors relevant to assessing comparability



A range of comparability-related metrics can be derived from a narrow set of quantifiable factors (at top). Some relevant factors (below) are only partly reflected in these quantified metrics, and generally are less readily quantified and compared.

of emission reduction. In all cases, one critical variable is the element of time—whether the metric is applied at a given point in time, or over a period of time. Particular metrics are sometimes associated with certain comparability principles—for example, cumulative emissions as a proxy for "responsibility," or mitigation cost per GDP for "capability."

An important consideration in relying on such metrics is the quality of the underlying data. In the case of developed countries, reliable data on current population and GDP are widely available, and national greenhouse gas inventories are submitted and reviewed under the UNFCCC. However, unlike these factors, which can be measured or estimated, mitigation cost is a calculation based on a range of factors and assumptions, and is therefore subject to greater uncertainty. For all of these factors, there is added uncertainty when projecting into the future. This is especially true in the case of mitigation costs, as is discussed below.

Beyond these core factors are a wide array of specific national circumstances that strongly influence many countries' perspectives on comparability. For instance, countries with more extreme climates may have greater heating or cooling needs. Some countries are well endowed with coal while others have greater wind, solar, or hydropower resources. Some are more economically dependent than others on GHG-intensive exports. While all of these factors are to some degree quantifiable, in most cases there are limited sources of consistent data across countries, so precise comparisons are more difficult. A number of these factors are also shown in **Figure 1**.

Choosing a Time Horizon

In weighing the comparability of future mitigation efforts, the most common yardstick is change in emissions from a common starting point to a common future end point. For instance, the targets in the Kyoto Protocol specify a percentage reduction (or, in a few cases, increase) in emissions from 1990 to 2008-2012. Altering either the base year or the compliance period can influence how comparable targets may appear.

Depending on the base year chosen, certain factors bearing on countries' emission profiles are implicitly given greater or lesser weight. An historical base year, e.g. 1990, gives greater weight to the efforts countries have—or have not—taken from that time to the present. If all countries were required to reduce their emissions by the same percentage from an historical base year, those with stronger past efforts would be required to do comparatively less from the present to the future end point. An historical base year also assigns greater weight to circumstances other than "effort" that may have contributed to changes in emissions since then. It will be more favorable to countries that for reasons such as economic restructuring have experienced a decline in emissions, and less favorable to those that for reasons such as population growth have experienced an increase in emissions.

A current or recent base year, on the other hand, deemphasizes past efforts or other changes in circumstance. In a sense, it wipes the slate clean. Countries that have acted to reduce emissions would receive no implicit credit for their efforts; they would be required to do more under targets requiring uniform percentage reductions from a current base year than they would under targets requiring the same percentage reduction from an historical base year. Conversely, a current base year is more favorable to countries that have not yet acted to reduce emissions, or have experienced circumstances contributing to emissions growth.

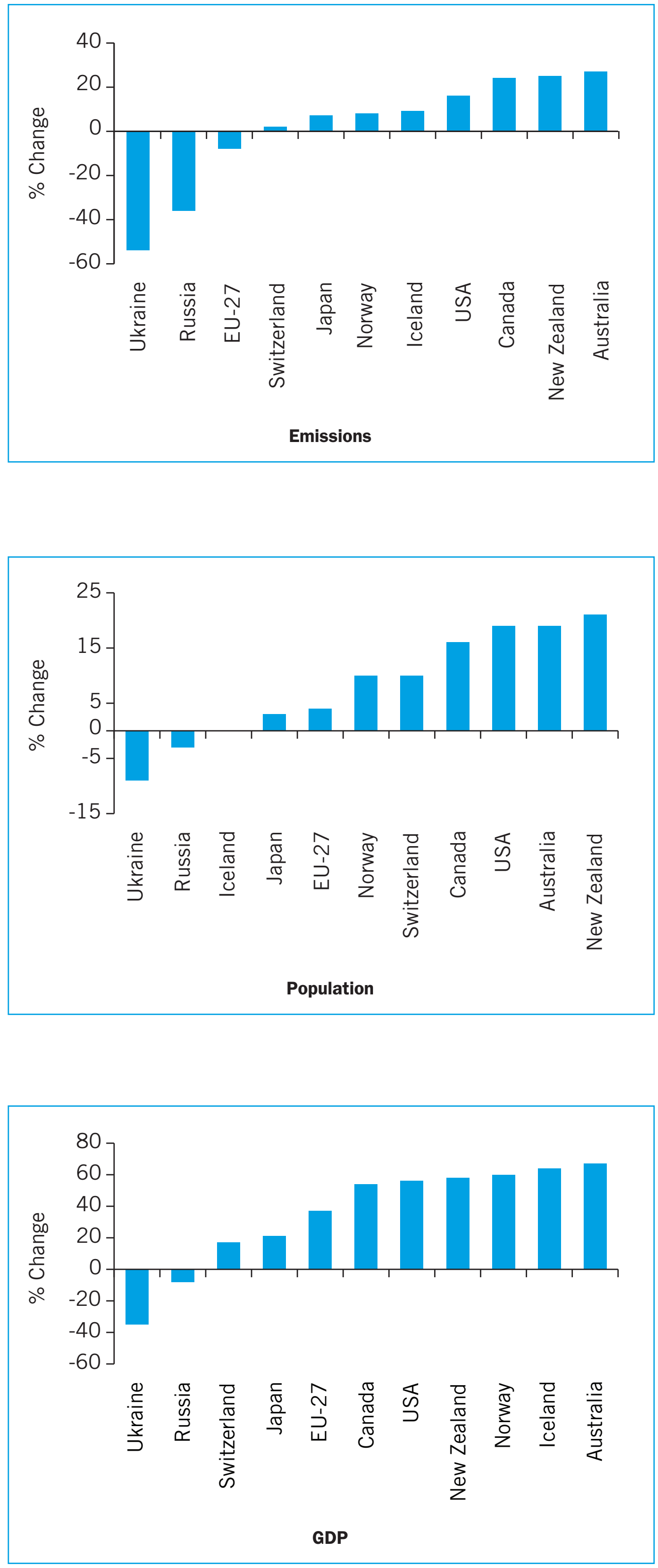
To date, targets under the UNFCCC and the Kyoto Protocol have relied primarily on a 1990 baseline.[2] In the current negotiations, some parties have called for consideration of alternative or supplemental base years, such as 2005, or for expressing targets in terms of absolute tons of allowable emissions, with no reference to a base year.

Figure 2 shows how the emissions, population, and GDP of the major developed country parties changed from 1990 to 2005. **Figure 3** blends these metrics to show how total emissions, per capita emissions, and emissions intensity (emissions per unit GDP) have changed relative to one another. Emissions intensity has declined in all of these countries. Per capita emissions have either declined or, in those countries with steady or rising emissions, have grown less than total emissions. All three measures declined only in Europe (EU-27), Russia and the Ukraine.

Figure 4 illustrates how countries would fare using alternative base years. It shows how much each would be required to reduce its emissions from 2005 levels under two scenarios: uniform targets of 25 percent below 1990, and uniform targets of 25 percent below 2005. (Note: The specific targets represented are illustrative only and are not intended to reflect preferred outcomes or the positions of individual parties.)

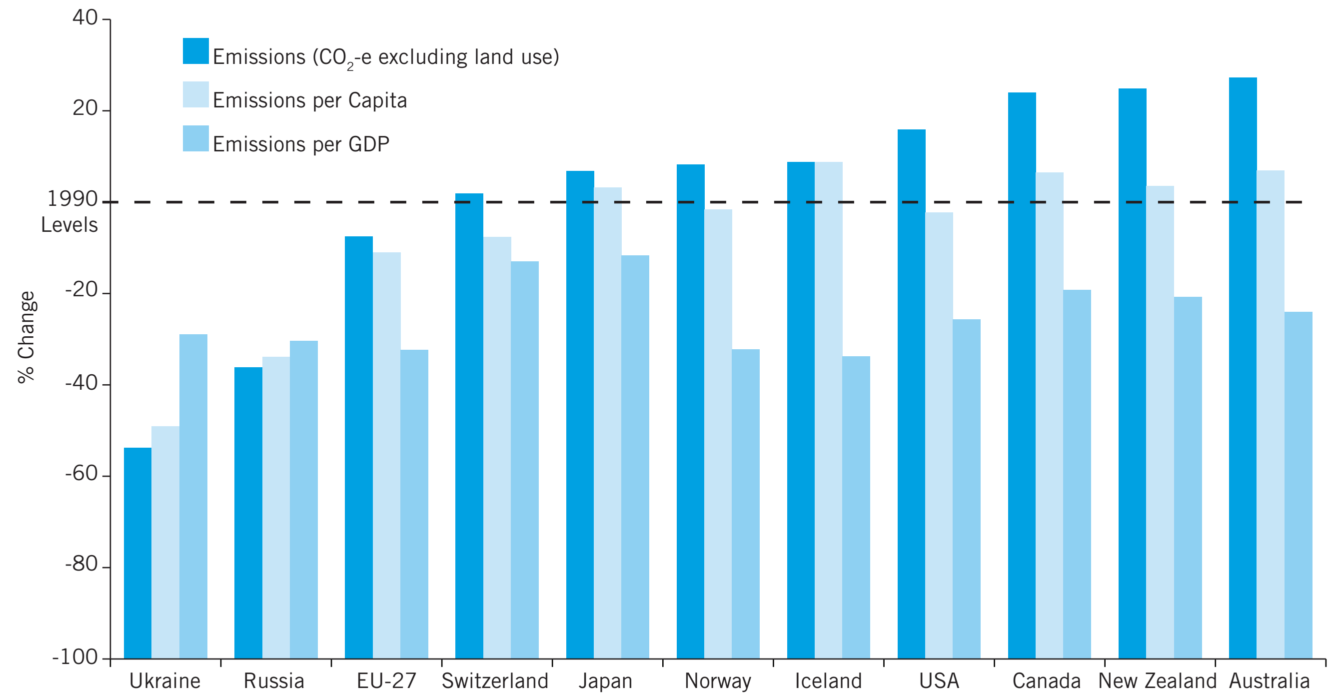
As can be seen, for countries whose emissions have declined since 1990 (EU-27, Russia, and Ukraine) due to past

Figure 2. Percentage change in emissions (CO_2-e excluding land use), population, and GDP, 1990-2005



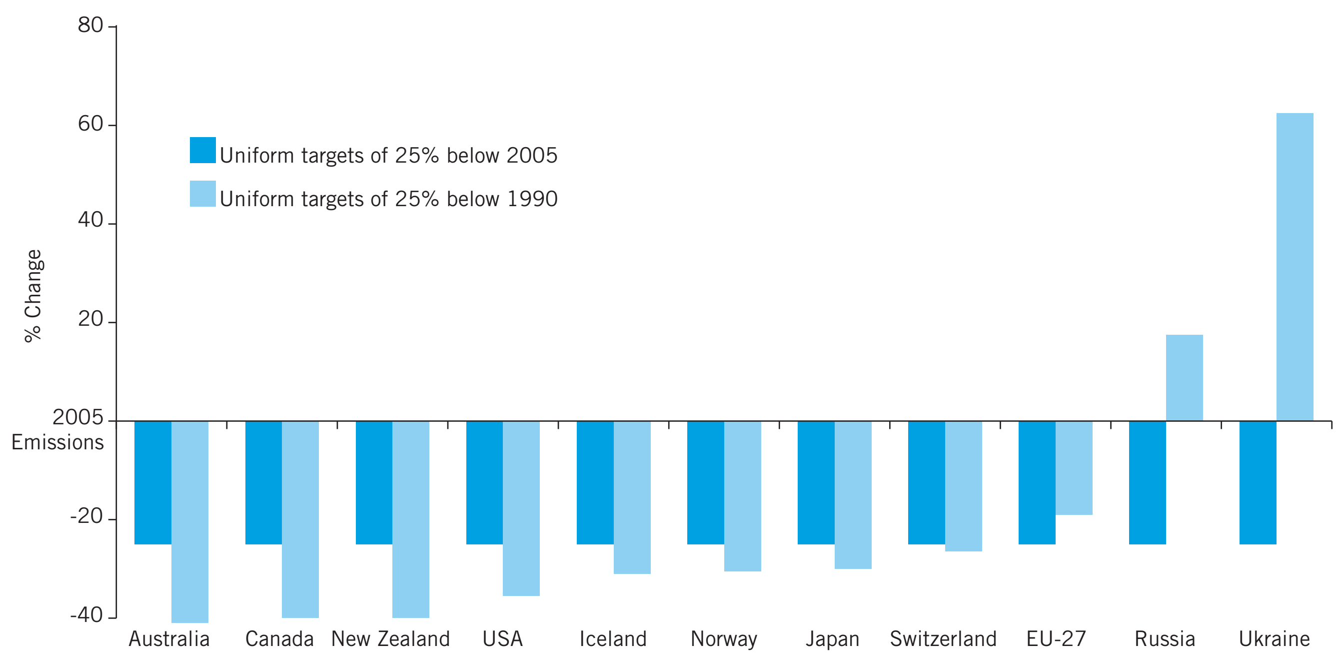
Source: Developed from IEA statistics (energy-related emissions only)

Figure 3. Relative changes in total emissions, per capita emissions, and emissions intensity, 1990-2005



Source: Developed from IEA statistics (energy-related emissions only)

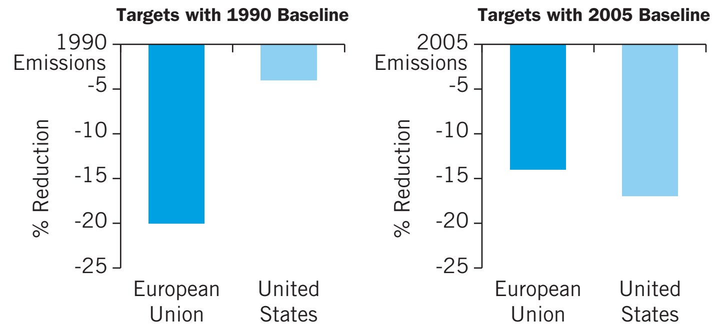
Figure 4. Alternative base years (reductions relative to 2005 emissions)



Source: Figures developed from UNFCCC/GHG Data/Time Series-Annex 1/1990-2005

Comparing EU and US Targets

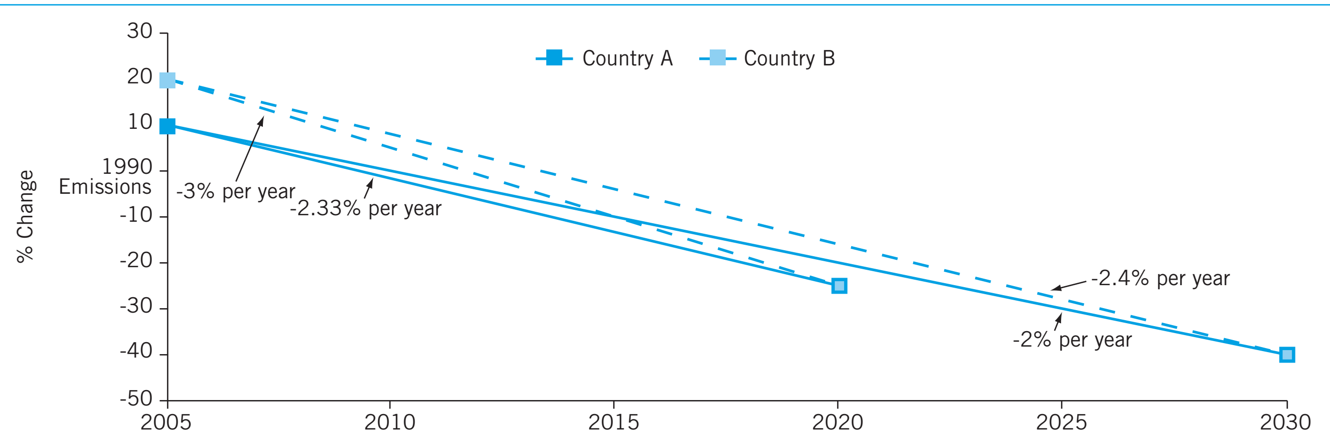
The relevance of base years is starkly illustrated by the comparison of 2020 emission targets for the European Union (EU-27) and the U.S. The figure on the left shows the EU's present target, and the target contained in legislation passed by the U.S. House of Representatives (but not yet enacted), against a 1990 baseline. The figure on the right shows the same targets against a 2005 baseline. The difference reflects the fact that Europe's emissions have largely leveled since 1990, while U.S. emissions have continued to grow.



mitigation efforts or for other reasons such as declining population or GDP, an equal reduction from a 1990 baseline would require a comparatively smaller reduction from 2005 (or allow an increase). On the other hand, for countries that have experienced significant emissions and population growth since 1990 (Australia, Canada, New Zealand, and United States), an equal reduction from a 2005 baseline would require a comparatively smaller reduction from 1990 (or allow an increase). For a country like Switzerland, whose emissions have not changed significantly since 1990, neither baseline confers a major advantage.

The comparability lens can also be refocused by altering the other key time variable—a target's end point. This is particularly true in the case of targets pegged to an historical base year. If the base year is 1990 and the compliance date is 2020, a uniform target would imply very different levels of reduction (from current emissions) for different countries. Annual rates of reduction would vary widely. To achieve more consistent annual rates of reduction, target values (e.g., -15 percent or -30 percent) would have to vary widely. However, as seen in **Figure 5**, a later target date such as 2030 spreads the required reduction over a longer period of time. Uniform targets would in that case imply less variation in annual rates of reduction. A later target date might therefore allow target values that are less disparate and, consequently, appear more comparable.

Figure 5. Altering a target's end point



In this hypothetical illustration, countries A and B start at 10% and 20%, respectively, above 1990 levels. If both must reduce to 25% below 1990 in 2020, the difference between their annual rates of reduction is 0.67%. However, with a more ambitious target (40% below 1990) at a later date (2030), the difference between their annual reduction rates is only 0.4%.

Comparing Mitigation Cost

Another factor weighing heavily in parties' assessments of comparability is the potential cost to countries of meeting their respective targets. Abatement cost is typically expressed in two ways:

- *Marginal abatement cost*, or the per-ton cost of removing the last ton of GHGs to achieve a given target; and
- *Total abatement cost*,[3] or the total expenditures required to achieve a given target, often expressed as a percentage of GDP.

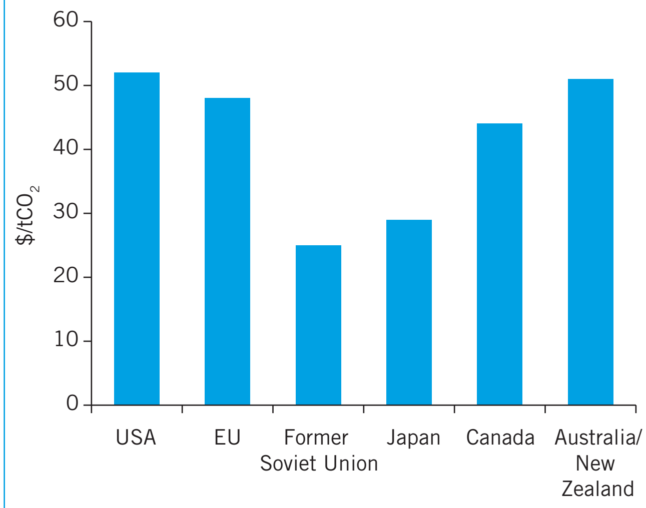
Projections of abatement cost are produced by economic models that rely on many key assumptions, and are therefore subject to a wide range of uncertainties. Cost projections often vary considerably depending on the model[4] and the assumptions employed. Among the more critical assumptions are the economic baseline (how an economy is projected to perform in the absence of climate policy); projected emission trends; existing and anticipated GHG policies; and future technology costs and availability. Divergent models and assumptions make consensus on any given set of projections difficult.

Marginal Abatement Cost

Marginal cost is most relevant to comparability as a factor in assessing respective mitigation potentials. Marginal abatement costs vary considerably across countries depending on their economic and energy profiles, past mitigation efforts, expected emissions growth, resource constraints, technology options, etc. As illustrated in **Figure 6**,[5] uniform reduction targets (in this case, 25 percent below 2005 levels by 2020), imply very different marginal costs for different countries.[6] (It is important to emphasize that these results are drawn from a single model and, hence, reflect a given set of assumptions. For instance, Japan's marginal abatement costs appear much lower than most other countries' in part because the "reference" or business-as-usual case in the model assumes that Japan's emissions will decline by 2020, while other countries' emissions will grow. Altering those assumptions would produce different cost projections.)

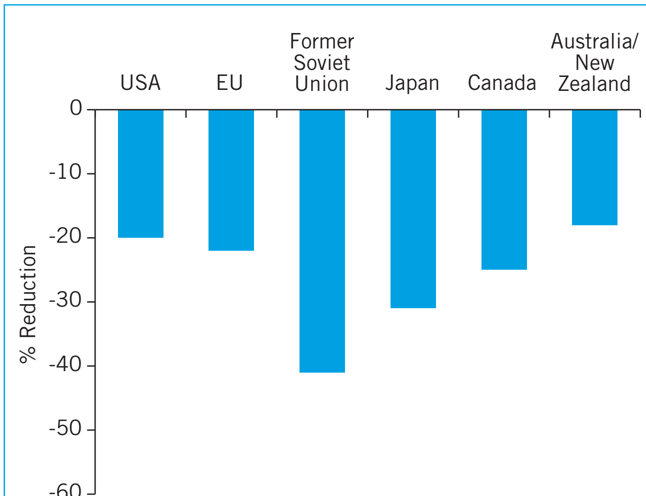
The converse is also true. As illustrated in **Figure 7**, if countries were each to abate to the same marginal cost (with an aggregate reduction of 25 percent below 2005), the implied targets would be highly disproportionate, ranging from -20 percent to -41 percent. Countries or regions such as the Former Soviet Union (FSU) with lower-cost abatement opportunities and lower projected emissions growth would bear the most stringent emission reduction targets, a distribution of effort that by other measures might not appear "comparable."

Figure 6. Marginal costs with uniform targets



Marginal abatement costs with uniform 2020 targets of 25 percent below 2005

Figure 7. Targets with equal marginal costs



2020 emission targets with equal marginal cost and aggregate reduction of 25 percent below 2005 (no emissions trading)

Total Abatement Cost

Total abatement cost, computed as a percent of GDP to account for the differing size of economies, may be a better reflection than marginal cost of the overall effort a country must undertake to achieve a given level of emission reduction.

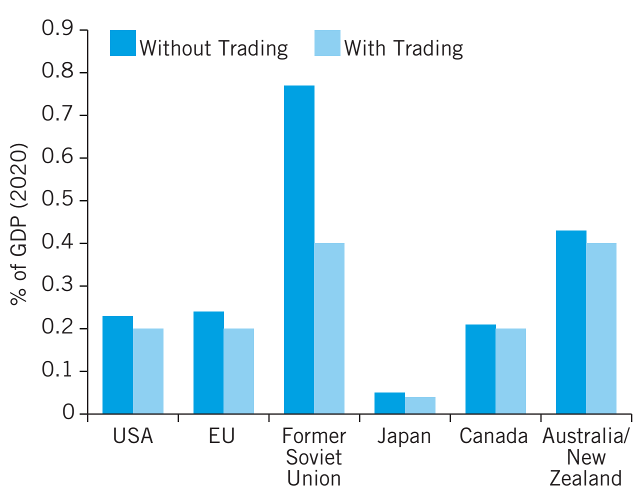
As with marginal costs, uniform reduction targets imply very different total abatement costs for countries. **Figure 8** illustrates total costs, as a percentage of GDP, under two scenarios. The first scenario is uniform targets of 25 percent below 2005 *without* emissions trading. (Although Japan and the FSU had the lowest marginal abatement costs, their costs per GDP diverge greatly. The FSU has the highest GDP costs, in part because its emissions intensity, or emissions per GDP, is relatively high. By contrast, Japan has the lowest emissions intensity.)

The second scenario assumes the same targets, but this time *with* emissions trading. As can be seen, trading lowers total abatement costs marginally for most countries, and significantly for the FSU. (Because the FSU has lower-cost abatement opportunities, it can reduce the cost of meeting its target by selling excess reductions to other countries; these countries, in turn, realize lower compliance costs by buying these lower-cost reductions.)

The principal virtue of trading is that, by equalizing marginal costs across countries, it ideally achieves a cost-effective distribution of the overall abatement effort. If trading is assumed, it is also theoretically possible to differentiate targets in a way that equalizes total abatement costs across countries, while still achieving a cost-effective distribution of abatement effort. **Figure 9** illustrates differential targets with equal total costs for countries, an aggregate reduction of 25 percent below 2005, and emissions trading. (Here, Japan's very stringent target again reflects the assumption that its emissions will decline under business as usual, while other countries' will grow; it is able to achieve a relatively greater reduction for an equivalent investment as percent of GDP.)

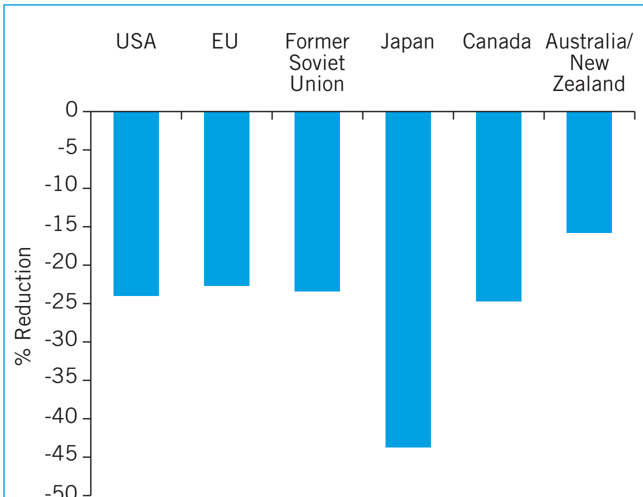
For many reasons, parties may not feel that "equal total costs" represents comparability of effort. For instance, countries that have undertaken stronger efforts in the past may feel that they should not bear the same relative costs as other countries going forward. Comparability could be understood, however, as a reasonable or acceptable distribution of costs taking into account other factors reflecting countries' individual circumstances.

Figure 8. Total costs with uniform targets



Total costs as percent of GDP with uniform 2020 targets of 25 percent below 2005, with and without emissions trading

Figure 9. Targets with equal total cost



2020 emission targets with equal total cost (as percent GDP) assuming emissions trading and aggregate reduction of 25 percent below 2005

Conclusions

Each of the many quantifiable metrics available provides its own unique slant on comparability. Given the diversity and divergence of factors shaping their circumstances, each country is likely to favor some metrics over others. As a result, parties are unlikely to address comparability by agreeing on an explicit formula to determine, or to assess the comparability of, their respective efforts. Rather, efforts are more likely to be agreed through political bargaining in which countries emphasize the metrics and national circumstances that most favor their positions. This process could be informed and assisted by an agreed set of data or analyses; full transparency would be critical to the credibility of, and parties' confidence in, these data. But in the end, the political outcome will likely rest on parties' mutual assessments of one another's efforts, employing the criteria they deem most relevant.

Notes

[1] In the case of developing countries, the Bali Action Plan calls for "nationally appropriate mitigation actions…in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner," with no reference to comparability. Accordingly, this brief looks at comparability only in the context of developed country efforts.

[2] 1990 was chosen primarily because it was the year for which the most recent data were available when the 1992 Framework Convention was negotiated. Alternative baselines are permitted for certain gases and countries.

[3] Total abatement cost is an incomplete measure of the full economy-wide cost of mitigation (the social or welfare cost). Social cost represents the opportunity cost to society of reallocating resources away from current uses toward mitigation activities. It reflects, among other things, indirect effects that take place outside of directly affected markets and are transmitted through price changes.

[4] "Top-down" or macroeconomic models are better at accounting for the indirect economic effects of climate policy but often poorly reflect important technology- or sector-specific dynamics. "Bottom-up" models draw on engineering studies to better represent the details of specific technologies but are not as good at capturing broader economic effects. The model's scope—global vs. national or regional—also will influence its results.

[5] The cost estimates in Figures 6, 7, 8 and 9 are derived from a series of modeling runs by the Joint Global Change Research Institute of the Pacific Northwest Laboratory/Battelle Memorial Institute and are presented for illustrative purposes only. The modeling was performed on MiniCAM, a global, long-term, integrated assessment model developed at Pacific Northwest National Laboratory and used to explore strategies for addressing climate change. For details on MiniCAM, see http://www.globalchange.umd.edu/.

[6] The marginal cost estimates presented here assume no emissions trading—i.e., each country achieves its required reductions domestically. Theoretically, allowing emissions trading across countries would equalize marginal costs, achieving the same global reduction at a lower overall cost.

This is one in a series of policy briefs examining post-2012 international climate policy. The Pew Center on Global Climate Change was established by the Pew Charitable Trust to bring a new cooperative approach and critical scientific, economic, and technological expertise to the global climate change debate. We inform this debate through wide-ranging analyses that add new facts and perspectives in four areas: policy (domestic and international), economics, environment, and solutions.

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