

A COPENHAGEN COLLAR: ACHIEVING COMPARABLE EFFORT THROUGH CARBON PRICE AGREEMENTS

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Executive Summary

The financial crisis and deep recession illustrate the unforeseen macroeconomic conditions through which climate policy must endure if it is to stabilize concentrations of greenhouse gases over the long run. It has made voters uneasy about climate policy that could raise energy costs and unemployment, even though the next agreement under the United Nations Framework Convention on Climate Change (UNFCCC) would likely not take effect until 2013, beyond the predicted duration of the current recession.

The downturn may make emissions targets harder or easier to achieve, which will complicate the UNFCCC process, which focuses almost exclusively on negotiating commitments by developed countries to reduce emissions relative to a fixed base year. Carbon emissions have likely fallen, so achieving a given target may now be easier. On the other hand, investment in emissions reductions will be more costly if credit markets continue to sputter and large government deficits crowd out private investment.

Although the recent turbulence has been global and unusually severe, significant disruptions occur at the regional and national level quite often. Trends in na-

tional emissions vary widely between countries, as do year-to-year fluctuations around those trends, so achieving similar targets can require very different levels of efforts in different countries. These differences have greatly hampered climate cooperation.

To help improve the political stability of any agreement emerging from Copenhagen, as well as to ensure the comparability of commitments and ease the inclusion of developing countries, we propose that the treaty supplement emissions targets with a price collar. The collar includes an initial price floor and price ceiling per ton of carbon equivalent emissions and an annual real growth rate for both. All major economies must show an effective price on emissions of at least the price floor even if they comply with their target. This prevents targets from being unexpectedly lax. Parties also cannot benefit from targets above expected emissions, such as those for the former Soviet Union under the Kyoto Protocol. The price floor also lowers the downside risk of low-carbon innovation.

Under our proposal, Parties would be allowed to exceed their targets if their price on emissions hits the price ceiling. This prevents the cost from becoming politically infeasible and accommodates developing countries like China that are uncomfortable with hard emissions caps. Developing countries could adopt a price floor without a target or price ceiling at first, and then transition to commitments more like those of industrialized countries.

We provide an example for the U.S. that shows that the price collar can have a negligible expected impact on the outcome that matters for the climate—cumulative emissions.

Implications of Economic Crisis for Climate Negotiations

The recent financial crisis and global economic downturn complicate climate negotiations under the UNFCCC. Perhaps the greatest effect of these developments is political. Policymakers in the U.S., Australia, Canada, and elsewhere face increased resistance from voters uneasy about domestic measures that could raise energy costs and unemployment. Automakers and other manufacturers fear that a cap-and-trade program could worsen their competitiveness and drive jobs overseas. These anxieties are real but they stem largely from short-run economic conditions. Although a cap-and-trade bill will indeed raise fossil energy prices, most studies suggest that the effects on output and employment over the long run should be modest. Further, both the draft bill in the U.S. Congress and the next UNFCCC agreement would likely not take effect until 2012 or 2013, beyond the predicted duration of the current recession. Climate policy, which must address an exceptionally long-run problem, is thus politically vulnerable to short-run macroeconomic conditions.

These short-run political difficulties are exacerbated by the UNFCCC focus on negotiating commitments by developed countries to sharp reductions in future emissions. The downturn has increased uncertainty in most countries about the cost of achieving a potential commitment. Data are not yet available, but it is likely that the economic downturn has reduced carbon emissions. Anemic economic growth could persist for several years, so achieving a given emissions target may require less abatement than previously expected. On the other hand, significant emissions reductions will require a high level of investment in new capital. This investment will be hampered if

credit markets continue to sputter and if large government deficits crowd out private investment through higher real interest rates. The downside of the downturn will be even worse for low-carbon investment if foreigners retreat from U.S. assets because they fear inflation or an eroding U.S. dollar.

The Need for a Better Basis for Negotiations

The UNFCCC talks scheduled for December 2009 in Copenhagen are meant to establish country-level commitments from the expiry of the Kyoto Protocol at the end of 2012 through 2020 and global emissions goals through 2050. But even as diplomats prepare for the new agreement, tensions around the formula for those commitments pose an important threat to success at Copenhagen and indeed the long term prospects for stabilizing the climate. This tension is clear from the failure of the G8 to set a base year for its agreed 80 percent reduction of emissions by 2050.

One of the greatest conflicts is the call for industrialized countries, particularly the U.S., to cut emissions deeply in the coming decade. The EU has called on the U.S. to take a target of 25 percent below 1990 levels by 2020 (about 35 percent below 2005 levels). India and other developing countries say the U.S. should cut emissions 40 percent below 2005 levels by 2020. These demands dampen prospects for agreement given that the climate bill passed recently by the U.S. House of Representatives seeks 17 percent below 2005 levels by 2020 for covered emissions. The Senate shows no appetite to strengthen targets as it now takes up the measure. One clear lesson from the Kyoto Protocol is that U.S. environmental policy is driven by domestic politics, not international commitments. U.S. negotiators could not accept a

target more stringent at Copenhagen without risking the treaty's defeat domestically.

The demise of the Protocol in the U.S. was driven both by the stringency of the U.S. target of 7 percent below 1990 levels and the exemption of major developing countries from emissions constraints. In his March 13, 2001 letter to then-Senator Chuck Hagel announcing the withdrawal of the U.S. from the Kyoto treaty, President Bush cited both the potential effects of the Protocol on energy prices and its exemption of "80 percent of the world." Since Kyoto, the international process has grappled with these issues. The UNFCCC's 2007 Bali Plan of Action calls for the Copenhagen agreement to ensure the "comparability of efforts" across developed countries while "taking into account differences in their national circumstances."

The experience of Kyoto illustrates the challenge of achieving "comparable efforts." The Kyoto targets were primarily reductions relative to 1990. However, different industrialized countries had very different patterns of economic growth and emissions from 1990 to 1997, when the Protocol was negotiated, and to 2008 when the treaty would take effect. For example, the U.S. economy grew by about 9 percent from 1990 to 1997, with emissions growing as well, albeit at a lower rate. In contrast, emissions in the United Kingdom and Germany fell substantially in that period due to changes in coal policy in the U.K. and the collapse of the Soviet Union and annexation of East Germany into West Germany. Yet, despite those important differences, many negotiators erroneously assumed that similar targets meant similar levels of effort. Drawn from work by Christopher MacCracken and others, [Figure 1](#) shows the relationship between projected emissions for 2010 under business as usual

conditions and the Kyoto Protocol target for five groups of countries. The higher the bar, the tighter the target. The chart shows that although the U.S. target was one percentage point less stringent than the EU (7 percent reduction vs. 8 percent reduction relative to 1990 levels), the U.S. target required significantly more emissions reductions relative to business as usual to achieve than the EU target. As shown by the yellow bar in [Figure 1](#) for the former Soviet Union (FSU), ignoring post-base-year events can lead to “hot air,” targets that are looser than expected emissions.

We see some of the same challenges to achieving comparable effort at Copenhagen. The EU routinely expresses its pledge relative to 1990 levels whereas President Obama proposes a 14 percent reduction relative to 2005 levels by 2020. Japan also prefers a 2005 base year. But just as in 1997, highly varying rates of baseline economic growth, fossil fuel use and availability, land use and agricultural sources and sinks, and historical energy intensity make it impossible to gauge the effort required to achieve a commitment by looking only at a gross emissions target relative to a historical base year's emissions. The focus on base years particularly alienates rapidly industrializing countries such as China and India that will be expected to take on binding emissions obligations eventually if not in 2013. Equal percentage departures from historical base year emissions might seem fair, but ignoring those baseline differences could impose quite different costs per capita, percentage GDP losses, and marginal abatement costs across countries. Thus the problem of crafting commitments at Copenhagen is as much a problem of the “optics” of the target formulation as it is the actual level of emissions.

But even if Parties negotiated emissions levels rather than reductions, they are not assured of comparable efforts because many things that affect the burden of

achieving the target can happen between the year of negotiation and the commitment period. The recent financial crisis and global economic downturn are clear reminders of the volatility in the underlying economic environment in which Parties make these emissions commitments. Additional uncertainties include unanticipated economic growth, technology breakthroughs, prices for renewables and natural gas (a lower-emitting alternative to coal), and political instability. To properly protect the climate, the international regime should endure through any number of economic and political fluctuations.

A Price Collar for Major Economies

Here we offer a way to ensure the comparability of efforts based on achieving comparable price signals on carbon. Similar price signals mean that countries will undertake similarly expensive measures to control pollution. This not only promotes transparently comparable effort, but also helps lower the overall cost of achieving a particular level of climate protection.

Under our proposal, all major Parties need to show at least a minimum level of effort regardless of whether they achieve their emissions target, and they would be allowed to exceed their target if they are unable to achieve it in spite of undertaking a high level of effort. Specifically, in addition to a cumulative emissions target for the 2013 to 2020 period, major economies would agree on three things, known collectively as the “price collar”:

1. A starting floor price on a ton of carbon dioxide-equivalent emissions for 2013;
2. A starting price ceiling on a ton of carbon dioxide-equivalent emissions for 2013; and

3. An annual rate of growth in the price floor and ceiling that reflects the real rate of interest, such as 4 percent.

To comply with their treaty obligations, Parties must demonstrate two things. First they must show that they have imposed a price on carbon equivalent emissions at least at the agreed floor price over most or all of the commitment period. Second, Parties must show that their cumulative emissions are no higher than their announced target OR that their domestic price on emissions has reached at least the ceiling price for a reasonable proportion of emissions within the commitment period.

This approach has several advantages. The price ceiling allows Parties to comply even if their target turns out to be unduly stringent. The price floor ensures that no Party's commitment is unduly lax and prevents Parties from benefiting from overly generous target formulations (such as the hot air for the FSU under the Kyoto Protocol). The approach accommodates developing countries like China that are uncomfortable with hard emissions caps but might be open to imposing a carbon tax. One approach would be to allow such countries to adopt a price floor without a target or with a low price ceiling at first, and then transition to commitments more like those of industrialized countries. Developed countries also need not agree on a common price collar, as long as they were comfortable with any differences, but competitive concerns would provide some incentive to converge.

Several implementation details would be required. First, the UNFCCC would have to develop guidelines on demonstrating compliance with the price collar. This would include methods of verifying price signals

and the extent to which they were in effect. The treaty must also ensure that excess emissions are reasonably proportional to the degree to which the price ceiling binds, measured for example by the duration over which the price ceiling applies, the share of total allowances the government sells at the ceiling price, or the share of emissions taxed at that rate. High excess emissions would need to be accompanied by a long duration of prices at the ceiling or a relatively large share of allowances transacted at the ceiling price.

Parties can implement their commitments as they see fit domestically, including through a tax or cap-and-trade system that provides transparent price signals. Regulatory measures would require special provisions to demonstrate their equivalence to a price signal. For example, countries could calculate a shadow price on emissions analogous to the way the World Trade Organization converts trade protection policies into tariff equivalents. Parties could count toward their price signals any existing fossil energy taxes, but such credit would have to be net of any subsidies to fossil energy or other greenhouse gas emitting activities. Parties could control any revenues generated by their domestic climate policy and use it to offset other tax burdens if they see fit.

The domestic mechanics of the price collar could work in a number of ways within a cap-and-trade system. For example, a central bank of carbon could intervene by buying or selling permits to keep the price within bounds. This is similar to the open market operations of the Federal Reserve in short term money markets. Alternatively the government could place a reserve price on allowances that it auctions.

Establishing comparable national price targets across countries means that trading of permits across coun-

tries would be unnecessary, adding to the system's robustness by avoiding a fragile international regime based on a common allowance market. McKibbin and Wilcoxon (2002) and McKibbin, Morris and Wilcoxon (2009) explain the advantages of coordinated national institutions over global institutions for creating a robust policy regime.

In our approach, the price floor ensures that no Party can use terrestrial sinks alone to meet its commitments. However, the agreement should specify how Parties will account for land-based carbon stock changes when targets are set. Another important element of the agreement is the level of technology transfer and financial assistance to developing countries. Given the complexity of developed country commitments, these issues are best handled separate from the target-setting negotiations.

Some environmentalists are uncomfortable with a price collar approach, domestically or internationally. Some believe that any limit on the price of allowances undermines the environmental integrity of the commitment. However, this belief gives moral status to the cap, an essentially political decision. Even if climate science can inform policymakers about the relationships between greenhouse concentrations and climate impacts, science alone cannot balance the tradeoffs across the benefits and costs of particular short run targets for individual countries. Further, if Parties can only adopt hard targets as commitments then they may choose looser caps or none at all rather than risk excessive stringency or non-compliance.

Another argument against putting an upper limit on carbon prices suggests that very high carbon prices spur technologies that will eventually provide low cost abatement, thus obviating the apparent cost savings of a limit on carbon prices. Clearly, a limit that

is lower than the expected carbon price can discourage investment in abating technologies relative to the case without the limit. However, by establishing a price floor as well as a price ceiling—at appropriate levels—a price collar both prevents the collapse of the program and limits the downside risk for investors in low carbon technologies. Both factors bolster investment confidence. Further, we question the notion that volatile near-term prices for carbon will induce sufficient technological development to lower prices in the long run by an amount sufficient to provide positive net present value. Rather, the economic literature has long supported the cost-minimizing case for gradually increasing prices on carbon.

An Illustrative Price Collar for the U.S.

To illustrate how a price collar could work, we constructed several representative climate policy scenarios using the G-Cubed intertemporal general equilibrium model, a widely used model of the global economy. First we established a “reference scenario” that reflects our best estimate of the likely evolution of each region's economy based on the relationship between economic growth and emissions growth in the model's regions over the last decade. The reference scenario also included the effects of climate policies already announced or implemented by governments other than the United States.

The first U.S. policy scenario we present is a target path for U.S. emissions that approximates the Obama administration's proposed targets for 2020 and 2050 of 14 percent and 83 percent reductions, respectively, from 2005 emissions levels. Details appear in Table 4 of McKibbin, Morris, Wilcoxon and Cai (2009). The scenario assumes a cap-and-trade program with a linear path of emissions caps from 2012 to 2020, and then another linear path from 2020 to 2050. It

requires the U.S. to hit each year's emission target exactly, with no flexibility about when the emissions reductions would occur. Also the scenario includes no offsets or other cost containment provisions. Although these assumptions differ from how the program would likely work in practice, the scenario is useful because it produces a price path that can illustrate how the price collar could work.

In our second scenario, we supplement the targets with a price floor and ceiling that are \$10 and \$35 respectively per ton of CO₂ emissions in 2012, both rising at 4 percent annually. [Figure 2](#) shows the allowance prices that emerge in the two scenarios. The dashed path labeled "Without Collar" is the price of a ton of carbon dioxide that would emerge if the economy is required to achieve the emissions targets in each year, without allowing banking, borrowing, or offsets. The shaded region shows the range between the price floor and price ceiling defined above. The solid line labeled "With Collar" shows the price that would prevail with the collar in place. It and the "Without Collar" curve coincide in the range between the price floor and the price ceiling.

The price floor triggers briefly at the start, during which time the government would remove some permits from the market. Over the subsequent decade the permit price stays within the price collar. By 2023, the strong demand for permits causes the market price to hit the ceiling and the government offers additional permits at the ceiling price as described above (this is similar to the McKibbin and Wilcoxen (2002) Hybrid proposal). By 2042, the price ceiling has become high enough that it rises above the market price of allowances. At that point, demand for additional permits drops to zero and emissions no longer exceed the annual cap.

[Figure 3](#) shows annual U.S. CO₂ emissions for the two scenarios. Under both policies, emissions fall in every year. With the price collar in place, emissions fall somewhat more slowly when the ceiling is binding. The additional permits are shown by the shaded area.

[Figure 4](#) shows the effects of both scenarios on cumulative U.S. emissions through 2050. Both reduce emissions substantially relative to the reference scenario and are generally very similar. In this example, introducing the price collar increases projected cumulative emissions by about 4 percent, or 6 billion metric tons, relative to the cap-and-trade scenario without the price collar. By imposing an upper bound on compliance costs, the collar increases the net present value of personal consumption (a measure of welfare) by \$80 billion relative to the scenario without the collar.

The cap-and-trade legislation currently under consideration by the U.S. Congress includes an important additional provision known as "banking" that allows firms to save unused allowances. Banking provides an incentive for firms to abate some of their emissions earlier than absolutely necessary in order to have more allowances in future years when caps are tighter. To examine the relationship between banking and a price collar, we constructed a third policy scenario in which firms were required to achieve the same cumulative emissions as the first simulation (without the price collar) but were allowed to bank emissions when it was profitable to do so.

[Figure 5](#) compares the estimated price trajectory of carbon allowances under the banking scenario (the dashed curve labeled "With Banking") to that for the price-collar case (the solid curve labeled "With Collar"). Each scenario includes only one of the two

mechanisms: no price collar is imposed in the banking case and banking is not allowed in the price collar case. From 2012 through 2023, the price-collar case lies below the banking case, indicating that the original emissions targets are relatively loose during the first decade. If permitted to do so, firms would want to do more abatement in order to bank allowances. The reduced number of allowances available for contemporaneous use would drive up the equilibrium price to the level shown by the “With Banking” curve.

From 2023 on, however, the two curves are essentially identical. Both rise at the interest rate until 2042 and after that they follow the original price trajectory. The reason the curves are similar is that our price collar is designed to be very similar to the cost-minimizing path (see McKibbin, Morris, Wilcoxon and Cai 2009 for discussion of the relationship between the banking and cost-minimizing paths). Had the initial price ceiling been higher, say \$36 per ton, the two curves would have crossed; the collar trajectory would have risen above the banking path.

By design, the banking scenario achieves the same cumulative emissions target as the original scenario, or 6 billion metric tons less than the price collar case. As shown in [Figure 6](#), the additional abatement occurs entirely during the first decade, when emissions are lower in the banking case than the price collar case (the shaded region in the figure). In subsequent years, allowance prices and annual emissions are equal in the two simulations.

A policy combining banking with a price collar will have the best features of both. As long as no macroeconomic surprises occur, banking allows firms to manage their abatement efficiently and thereby minimize the overall cost of achieving the desired emis-

sions reductions. As long as the price collar is set, as it was above, so that the expected market price and the ceiling would be consistently very close, there would be little or no incentive for firms to purchase additional allowances from the government. However, if unexpected events make abatement more difficult than expected, the price ceiling would come into effect, providing protection against sharp spikes in allowance prices. Moreover, our illustrative results above suggest that the consequent increase in cumulative emissions would be very modest.

Conclusion

Allowing for a price collar within a policy focused on long-run cumulative emissions targets is an effective and politically viable way to move international negotiations on climate policy forward. The economic uncertainty surrounding target commitments is enormous, and combining a clear cumulative emissions target with a price collar optimally balances the environmental objective with the need to ensure that commitments remain feasible. Using plausible assumptions, the example in this paper illustrates how a price collar does this.

Focusing exclusively on reductions from historical emissions as the only meaningful form of commitment has greatly hampered negotiations on climate commitments, especially for developing countries where the uncertainty about the future and the cost is greatest. In contrast, the price collar can ease major developing countries into the system by allowing them to adopt only a price floor in the early years. It also offers a transparent and verifiable assurance of the comparability of effort across countries. Further, Parties can design price collars so that they have no effect if predictions about the level of effort required to achieve a target are correct.

Including verifiable actions along with an emissions goal is an important improvement over the Kyoto Protocol because it demonstrates compliance during, as well as after, the commitment period.

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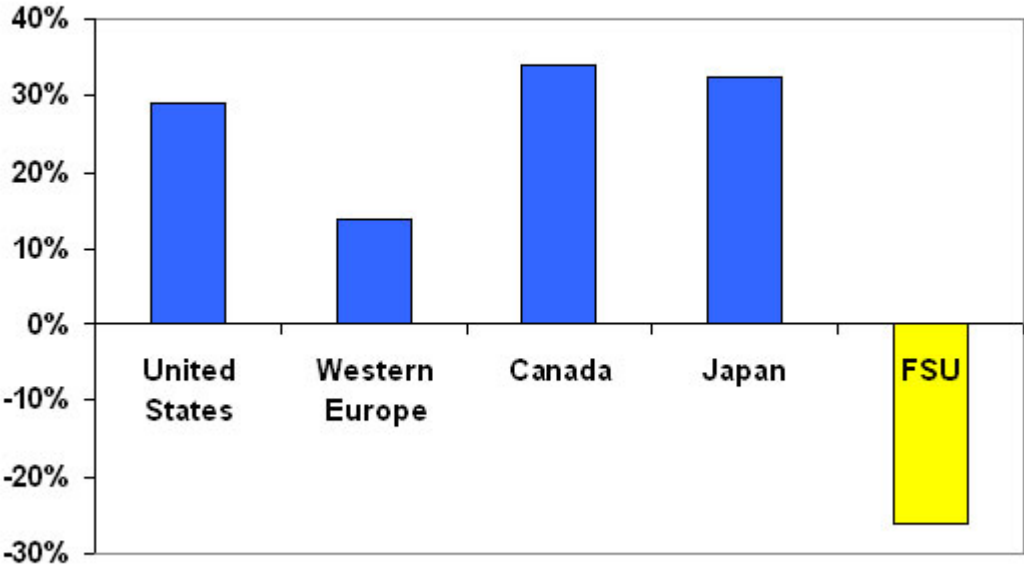
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Note

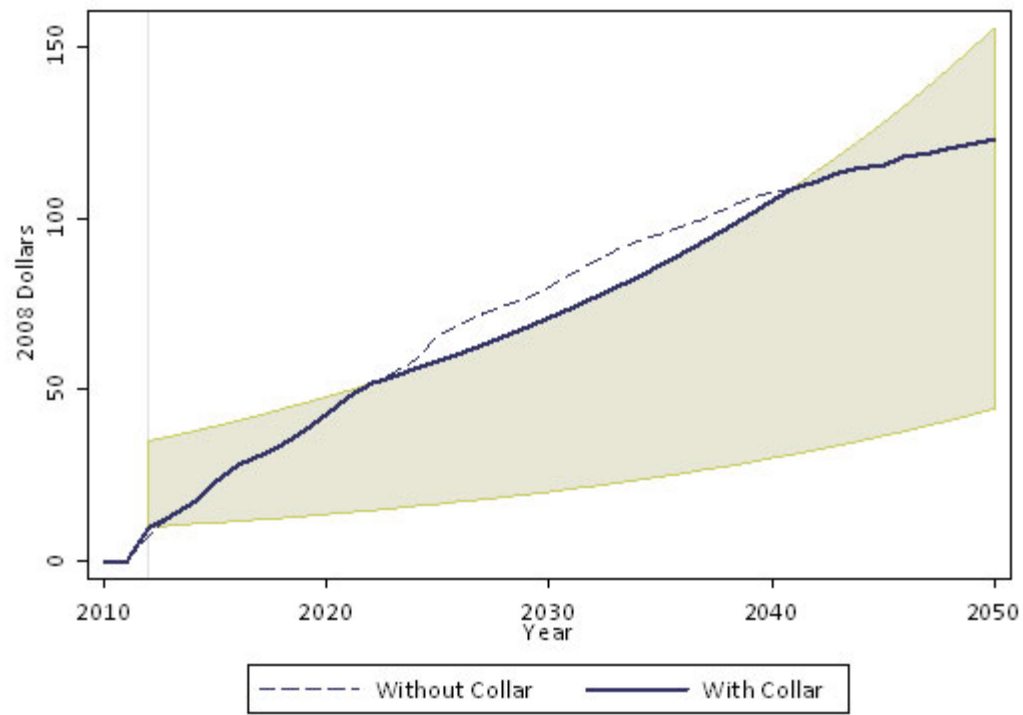
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Figure 1. 2010 Projected Emissions relative to Kyoto Protocol Targets



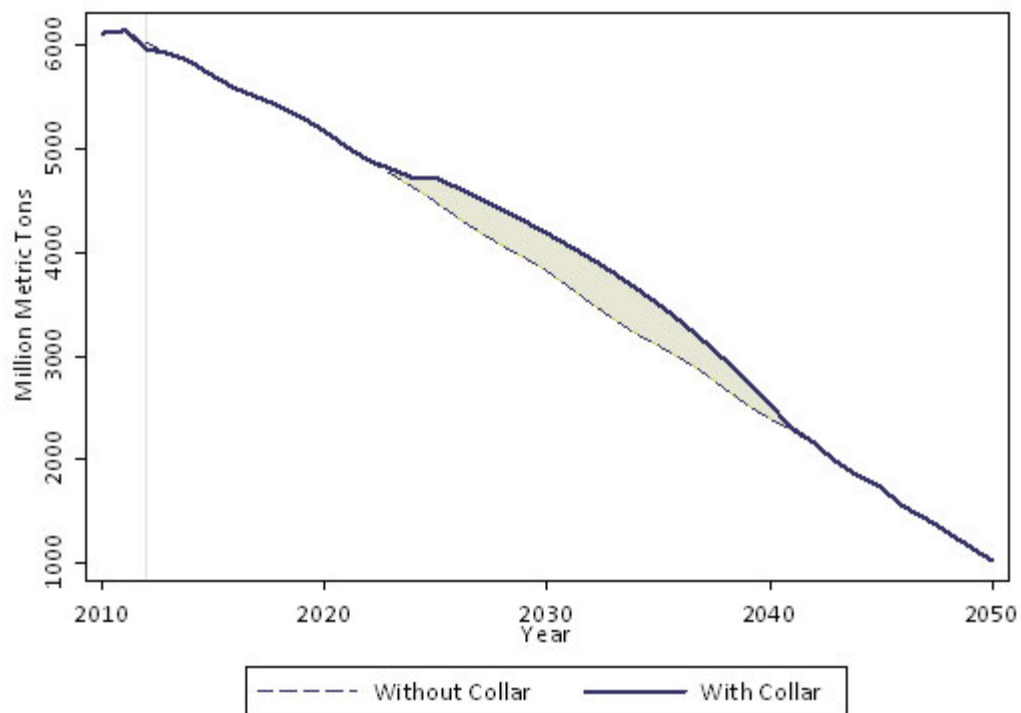
Source: McKibbin, Morris and Wilcoxon

Figure 2. Price per ton of CO₂



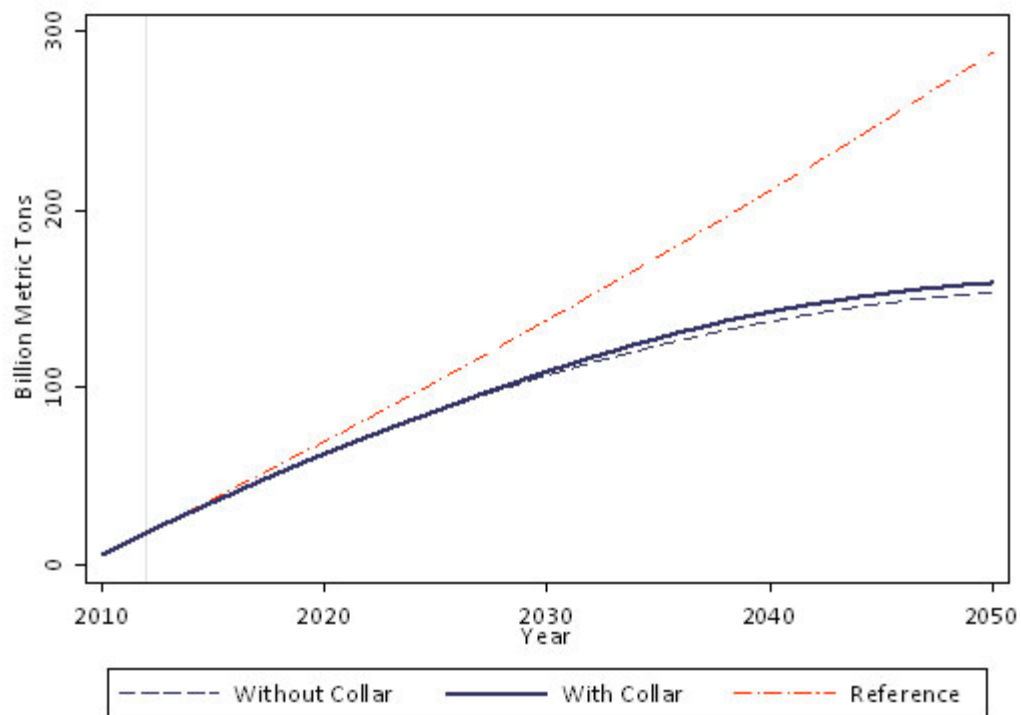
Source: McKibbin, Morris and Wilcoxon

Figure 3. U.S. CO₂ Emissions



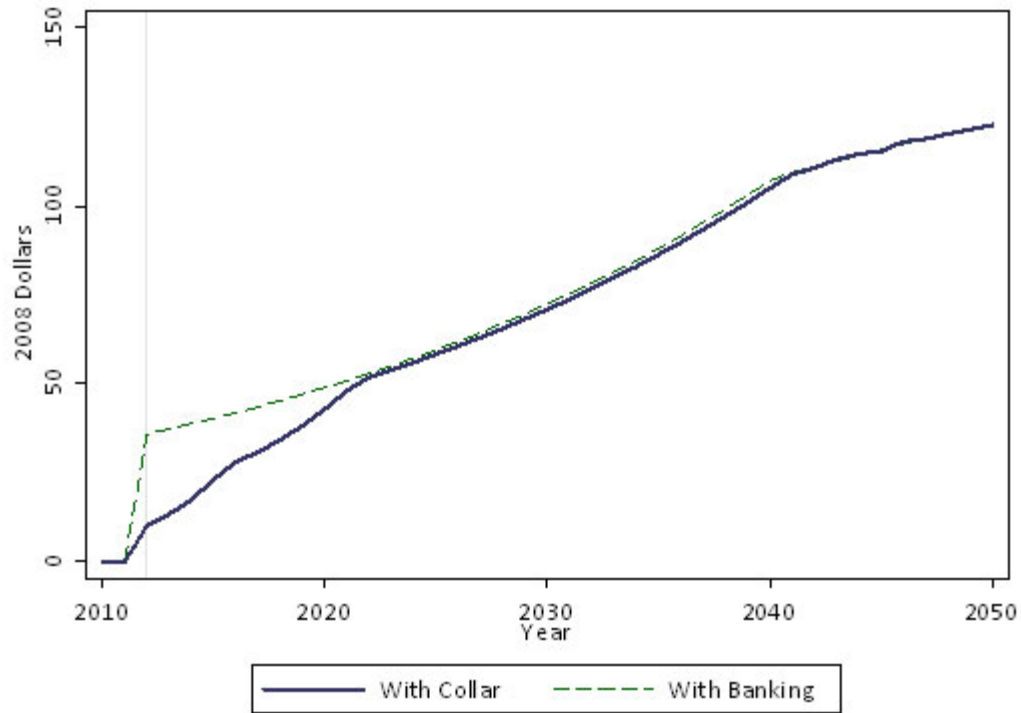
Source: McKibbin, Morris and Wilcoxon

Figure 4. Cumulative U.S. Emissions of CO₂



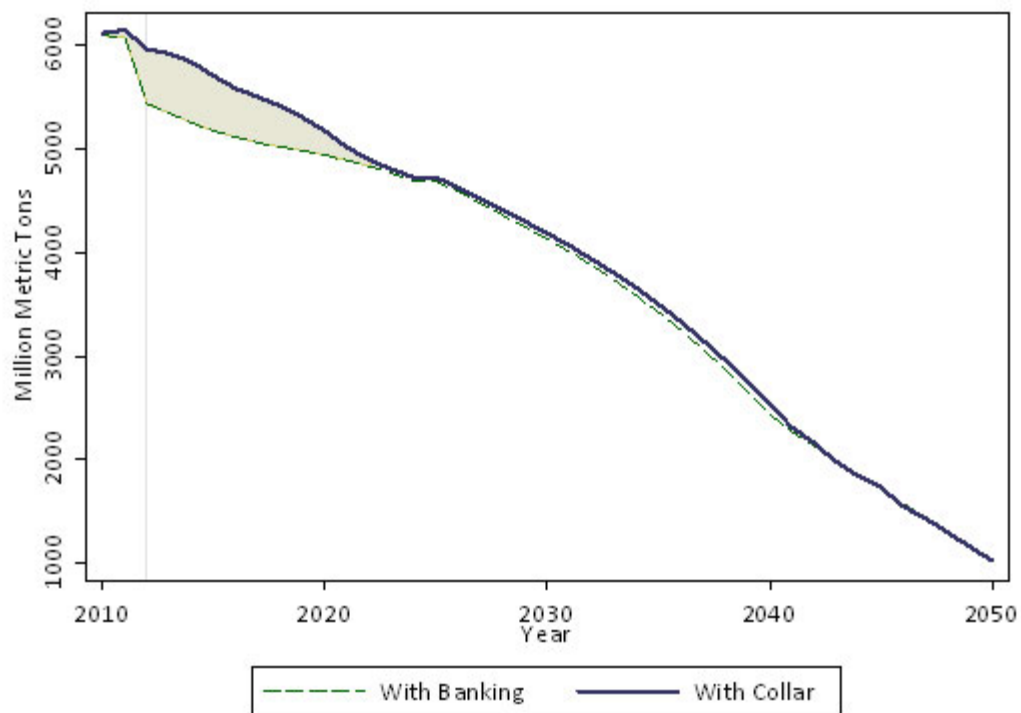
Source: McKibbin, Morris and Wilcoxon

Figure 5. Price per ton of CO2 with Banking and with a Price Collar



Source: McKibbin, Morris and Wilcoxon

Figure 6. Emissions under Banking and with a Price Collar



Source: McKibbin, Morris and Wilcoxon