ISSUE BRIEF

# Should the Obama Administration Implement a $CO_2$ Tax?

**Ian W.H. Parry**

RESOURCES FOR THE FUTURE

**April 2009**
**Issue Brief # 09-05**

## Resources for the Future

Resources for the Future is an independent, nonpartisan think tank that, through its social science research, enables policymakers and stakeholders to make better, more informed decisions about energy, environmental, natural resource, and public health issues. Headquartered in Washington, DC, its research scope comprises programs in nations around the world.

RESOURCES FOR THE FUTURE

1616 P Street NW
Washington, DC 20036
202-328-5000
www.rff.org

# Should the Obama Administration Implement a $CO_2$ Tax?

Ian W.H. Parry[1]

There is an overwhelming economic case for the Obama administration to impose, as soon as possible, a price on carbon dioxide ($CO_2$) and other greenhouse gas (GHG) emissions. But how high should the price be? Should it be implemented through an emissions tax or a cap-and-trade system? And how should the policy be designed?

## What is the Right Price for $CO_2$?

There are two distinct approaches for gauging the appropriate price to place on $CO_2$ and other GHGs. The cost-effectiveness approach assumes that policymakers have set a goal for limiting the amount of projected climate change or atmospheric GHG accumulations, and the question is what emissions pricing trajectories achieve this goal at minimum cost. The welfare maximizing approach involves balancing the marginal benefits from emissions mitigation against the marginal costs of abatement.

### COST-EFFECTIVENESS APPROACH

Largely due to emissions from fossil fuel combustion, atmospheric concentrations of $CO_2$ have increased from preindustrial levels of about 280 parts per million (ppm) to their current level of about 385 ppm (statistics here are taken from the Intergovernmental Panel on Climate Change report, IPCC 2007). This accumulation is largely irreversible—on average a ton of $CO_2$ remains in the atmosphere for about a century before being absorbed by the oceans and terrestrial carbon sinks. Accounting for the relative (lifetime) warming potential of other GHGs, like methane and nitrous oxides from agricultural and other sources, total GHG concentrations are now about 415 ppm in $CO_2$ equivalent. In the absence of emissions mitigation policy, $CO_2$ equivalent concentrations are projected to double their preindustrial levels around midcentury.

……………………………………

[1] Senior Fellow and Allen Kneese Chair, Resources for the Future.

Should atmospheric concentrations be stabilized at this level, the mean projection of the IPCC is that, once the climate system has fully adjusted (which takes several decades due to heat diffusion processes in the oceans) global temperatures will be 3°C higher than preindustrial temperatures, while if $CO_2$ equivalent concentrations were stabilized at 650 ppm, the mean projected warming is 3.5°C. Currently, global temperatures are about 0.75°C higher than preindustrial levels. However, there is considerable uncertainty surrounding future warming projections—particularly concerning the possibility of (poorly understood) feedbacks within the climate system which, conceivably, might result in much higher warming.

Most debate has focused on climate stabilization targets that are approximately consistent with limiting atmospheric $CO_2$ concentrations to either 450 or 550 ppm. With other GHGs included, that means $CO_2$ would be stabilized at somewhat less, or somewhat greater, than double preindustrial levels under these targets. A number of energy modeling teams have estimated global $CO_2$ emissions price trajectories that minimize the worldwide abatement costs subject to these long-run constraints on atmospheric accumulations. Not surprisingly, the model results are very sensitive to speculative assumptions about future emissions growth over the century in the absence of policy, the future availability and costs of emissions-saving technologies, and so on. Therefore, we cannot have much confidence in the results of any one particular model, but a reasonable flavor for the range of possibilities can be inferred from considering a representative selection of results.

One particularly good study by Clarke et al. (2007) contains projections from three modeling teams. According to their projections, $CO_2$ emissions prices need to rise to about $5 to $25 per ton by 2025 (in current dollars), and $10 to $70 per ton by 2050, to limit atmospheric $CO_2$ concentrations to 550 ppm at lowest cost. For this scenario, global $CO_2$ emissions would peak at about 20 to 60 percent above 2000 emission levels in the 2020 to 2040 timeframe, and then progressively decline thereafter. In contrast, the 450 ppm target requires far more aggressive policies that cut global emissions immediately and then reduce emissions to around half of 2000 levels by midcentury. This requires much stiffer $CO_2$ prices that, according to the same three models, would rise to $40 to $90 per ton by 2025 and $130 to $230 by midcentury. Under either target, the price of emissions would increase at roughly the market rate of interest over time, or about five percent.

These estimated pricing trajectories are based on the assumption that all countries join an international emissions control at the same time (in 2012) and impose the same price on emissions. In practice, it is likely to be some time before developing countries are willing to comprehensively price their emissions, and even when they do it may be at a lower rate than what prevails in Europe, the United States, and other developed countries. To stay within the target constraints for atmospheric $CO_2$ accumulations, these forgone emissions reductions in developing nations would need to be made up through some combination of greater near-term reductions in developed countries, and greater global abatement later on in the century. A study by Edmonds et al. (2008) suggests that, so long as developing countries like China begin to participate in emissions control agreements by about 2035, the appropriate near-term emissions prices in developed countries are not dramatically affected, if the goal is a 550 ppm $CO_2$ target. *However*, if the goal is to limit $CO_2$ concentrations to 450 ppm, delayed participation by developing countries much beyond 2020 can start to imply dramatically larger near-term emissions prices for developed countries.

To put these emissions prices in perspective, each $10 increase in the price on $CO_2$ increases coal prices to power companies by about 60 percent, wellhead natural gas prices by around 10 percent, retail electricity prices by about 7 percent, and gasoline prices by about 9 cents per gallon.[2] For this reason, and the wide array of alternatives to traditional coal-fired generation, most of the emissions reductions in the near to medium term (at both a U.S. and global level) are projected to occur in the power sector. This reflects a substitution away from the present coal technology to gas, renewables (wind and solar), nuclear, and coal plants with carbon capture and storage.

### WELFARE MAXIMIZING APPROACH

Economists generally favor imposing a price on GHG emissions that reflects the discounted value of worldwide future warming damages per extra ton of $CO_2$ (equivalent) releases. The damages reflect harm to global agriculture, costs of protecting against rising sea levels and increased storm intensity, health impacts from the possible spread of tropical disease, ecological impacts, the risks of extreme climate catastrophes, and so on.

Assessments of the damages from a given amount of future warming are highly uncertain, given that regional temperature and precipitation patterns are very difficult to project for a number of reasons—among them the future baselines for assessing impacts a hundred years from now are so uncertain and the difficulty of projecting future technologies that might be available to enable adaptation to climate change. Nonetheless, there's a general consensus in the economics literature that the damages from a warming of around 2-3°C occurring in about 2100 would amount to about 1 to 3 percent of world GDP. When discounted back to the present with market discount rates, most estimates of marginal damages from current emissions are around $5 to 25 per ton of $CO_2$ (e.g., Tol 2008). Marginal damages increase at around 2 to 3 percent a year in real terms, or roughly the growth in world output potentially affected by climate change.[3]

There are two main critiques of these price estimates. First, there is controversy over the rate at which to discount damages to future, unborn, generations. Some analysts argue, on equity grounds, that the burden on future generations should not be discounted at all. In that case the price of carbon could increase to around $80 per ton. The counter-argument is that market interest rates best reflect the preferences of the current generation and using a much lower rate would render policy analysis meaningless in many other contexts.[4]

The second critique is that mainstream estimates do not adequately handle the risks of catastrophic climate change. To the extent they have been incorporated in these price estimates, the procedure has been to attach a probability that a large portion (perhaps a quarter of world GDP), is lost to a catastrophic change in climate, at different levels of warming. However, this neglects the possibility of a truly catastrophic change destroying the planet as we know it—for example, a runaway warming effect caused by releases of

…………………………………..

[2] From Clarke et al. (2007), after updating to 2007 prices.

[3] At first glance it might be thought that the tax rate should increase at a faster rate, given that the damage from additional climate change rises with a greater amount of warming over time. However, this effect is roughly counteracted, because the extra warming from additional atmospheric accumulations declines at higher levels of concentrations.

[4] For example, if applied retrospectively, zero discounting of utility would imply that all previous generations should have substantially cut back their consumption to make the current generation (easily the wealthiest that has ever lived) better off.

underground methane that, conceivably, could increase temperatures by 15°C or more. Weitzman (2009) suggests that, accounting for this possibility, the marginal damages from current emissions could be arbitrarily large. However, from an insurance perspective, imposing draconian cuts in current emissions is an inefficient way to address the tiny risk of a truly catastrophic outcome. Insofar as possible, a more direct response would be to invest heavily in developing technologies for early detection of, and response to, catastrophes—for example, satellite monitoring to track for any signs of methane leakage and technologies that could be rapidly deployed to suck methane and other GHGs out of the atmosphere. Moreover, it might still be feasible for a midcourse policy correction to head off a catastrophic outcome, if needed, through draconian emissions reductions in response to future learning about the seriousness of global warming.

To sum up, a lower bound estimate of the economically efficient price on $CO_2$ emissions is around $5 to $25 per ton. Some economists, and many climate scientists, would argue for much more stringent pricing, on the grounds of intergenerational equity or minimizing climate risks. However, the economic case for more stringent pricing is much disputed.

## Domestic Policy Choice and Design

Debate about the choice of emissions control instruments is no longer about the superiority of market-based approaches over traditional forms of regulation, like mandates for specific technologies. Rather, it is between the two market-based alternatives, emissions taxes and cap-and-trade systems. However, what matters is not so much the choice of market-based instrument itself but rather whether the instrument is well designed or not. Aside from the emissions price, key design features relate to the point and coverage of regulations, to what extent the policy raises revenue, and, in the case of cap-and-trade systems, possible provisions to limit emissions price volatility.

### POINT AND SCOPE OF REGULATION

A $CO_2$ tax, or cap-and-trade system, can be imposed upstream on fossil fuel producers, where the tax or permit requirement is proportional to the carbon content of coal, oil, and natural gas. An upstream system effectively captures all sources of emissions when fuels are later combusted. Alternatively, these policies can be implemented downstream, at the point when emissions are released into the atmosphere. Downstream systems (like the emissions trading program in the European Union) are applied to power plants and large-scale industrial furnaces, which account for about half of U.S. or EU emissions. Because it is impractical to monitor other downstream emissions releases (e.g., from automobiles and homes), these systems may be combined with midstream regulations targeted at refined transportation and home heating fuels. Upstream systems are easier to administer than downstream systems, as they are applied to far fewer entities, and they can easily provide incentives for downstream emissions capture and sequestration at power plants and other facilities through appropriate crediting. As for greenhouse gases other than $CO_2$, any system—tax or cap-and-trade—should be extended as far as possible to include them either directly or through a system of credits for sources that can demonstrate that they have made valid reductions.

### FISCAL CONSIDERATIONS

A tax on $CO_2$ raises revenues that go to the government. A cap-and-trade system in its traditional form leaves the policy rents in the private sector through free allocation of allowances to the affected industries. However, a cap-and-trade system can easily be designed to raise revenues comparable to a tax by having the government auction off the allowances.[5]

Raising revenue creates a potentially large fiscal dividend. For example, a $20 per-ton tax on $CO_2$ would cut emissions (currently about 6 billion tons a year) by around 5 to 15 percent, and raise annual revenues in the order of $100 billion a year in the near term. If, for example, this revenue was used to reduce income taxes, the economic efficiency gains would be very substantial—perhaps around $30 billion a year. These gains arise through the effect of lower taxes on encouraging additional labor force participation, more investment and savings, and a reduction in the bias toward tax-favored spending, such as home ownership and employer provided medical insurance.

### PRICE STABILITY

An advantage of emissions taxes is that they fix the price of emissions over time, which helps to minimize abatement costs by equating the marginal costs of abatement at different periods of time. In contrast, under pure cap-and-trade systems, allowance prices will vary from year to year with changes in factors such as energy demand and fuel prices, raising abatement costs over time as there could be large divergences in marginal abatement costs across periods with high and low allowance prices. According to Fell et al. (2008), emissions price volatility might raise the discounted costs of a cap-and-trade system, relative to an equivalently scaled emissions tax, by around 15 percent—or roughly $4 billion a year on average under the Lieberman–Warner climate proposal.

Cap-and-trade programs can be designed with provisions that partly overcome this disadvantage. One possibility is to allow firms to bank allowances when prices are high, and run down previously banked allowances, or borrow allowances, when prices are high. Although existing, and prospective, programs usually contain such provisions, cost-savings are partly limited by restrictions on allowance borrowing as policymakers are concerned about the risk that a firm with a substantial accumulated permit debt may default. Another possibility for limiting volatility is to impose a "safety valve" where the government effectively steps in to supply additional allowances to the market in periods where the allowance price hits a certain ceiling level. The lower is the safety valve price, and the tighter the emissions cap, the more likely the price ceiling is binding, and the more frequently the policy behaves like an emissions tax.

### THE CHOICE

A revenue-neutral $CO_2$ tax is the ideal domestic emissions mitigation policy on economic efficiency grounds. Although emissions allowances can be auctioned and supplementary provisions included in cap-and-trade systems to partially limit price variability, why implement a more elaborate permit trading scheme if its

[5] Some compensation for affected industries might be needed as part of the political deal-making needed to move climate legislation forward, though the amount of compensation is a small fraction of the total market value of allowances, at least for a moderately scaled program (e.g., Bovenberg and Goulder 2001).

primary objective is to mimic the effect of a simpler emissions tax? A possible answer is that, for whatever reason, cap-and-trade systems appear to have more political traction. However, the prospects for revenue-neutrality might be weaker under this policy, even if all the allowances were auctioned. Revenues under a $CO_2$ tax would be under the purview of tax committees in the House and Senate, whereas under a cap-and-trade system disbursement of revenues would likely also involve environmental and energy committees that might be more predisposed to use revenues for other purposes with the risk that efficiency benefits from recycling are forgone.

## Conclusion

Rapidly expanding fiscal deficits have heightened interest in novel sources of ways to raise federal revenue, and a $CO_2$ tax, or cap-and-trade system with auctioned allowances, are obvious candidates. The case for an emissions tax over cap-and-trade is nuanced, because in large part cap-and-trade can be designed to look like a tax, though the tax provides a clear emissions price signal, and possibly offers more hope of efficient revenue use. Whichever instrument is chosen, it is critically important to design it well—to maximize coverage of GHGs, maximize revenue combined with efficient use of revenue, and contain price volatility. Moreover, the level of emissions pricing should be governed by environmental considerations, irrespective of the size of fiscal deficits. In fact, to maximize the prospects of large efficiency benefits, revenues from a new GHG emissions control program would be better used to cut other distortionary taxes, rather than paying down the deficit. Structural deficit problems are better addressed through broader reforms to the tax and public expenditure system.

## References

Bovenberg, A. Lans, and Lawrence H. Goulder. 2001. Neutralizing the Adverse Industry Impacts of $CO_2$ Abatement Policies: What Does It Cost? In *Behavioral and Distributional Effects of Environmental Policy*, edited by C. Carraro and G. Metcalf. Chicago: University of Chicago Press, 45–85.

Bovenberg, A. Lans and Lawrence H. Goulder. 2002. Environmental Taxation and Regulation. In *Handbook of Public Economics*, edited by A. Auerbach and M. Feldstein. New York: North Holland.

Clarke, Leon E., James A. Edmonds, Henry Jacoby, Hugh M. Pitcher, John M. Reilly, and Richard G. Richels. 2007. *Scenarios of Greenhouse gas Emissions and Atmospheric Concentrations*. Washington, DC: U.S. Climate Change Science Program.

Edmonds, J., L. Clarke, J. Lurz, and M. Wise. 2008. Stabilizing $CO_2$ Concentrations with Incomplete International Cooperation. *Climate Policy* 8: 355–376.

Goulder, Lawrence H., Ian W.H. Parry, Roberton C. Williams, and Dallas Burtraw. 1999. The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting. *Journal of Public Economics* 72: 329–360.

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Synthesis Report*. Geneva, Switzerland: Intergovernmental Panel on Climate Change.

Parry, Ian W.H. and Wallace E. Oates. 2000. Policy Analysis in the Presence of Distorting Taxes. *Journal of Policy Analysis and Management* 19: 603–614.

Tol, Richard S. J. 2008. The Social Cost of Carbon: Trends, Outliers, and Catastrophes. *Economics—the Open-Access, Open-Assessment E-Journal* 2: 1–24.

Weitzman, Martin L. 2009. On Modeling and Interpreting the Economics of Catastrophic Climate Change. *Review of Economics and Statistics*, forthcoming.