Carbon Pricing Methods

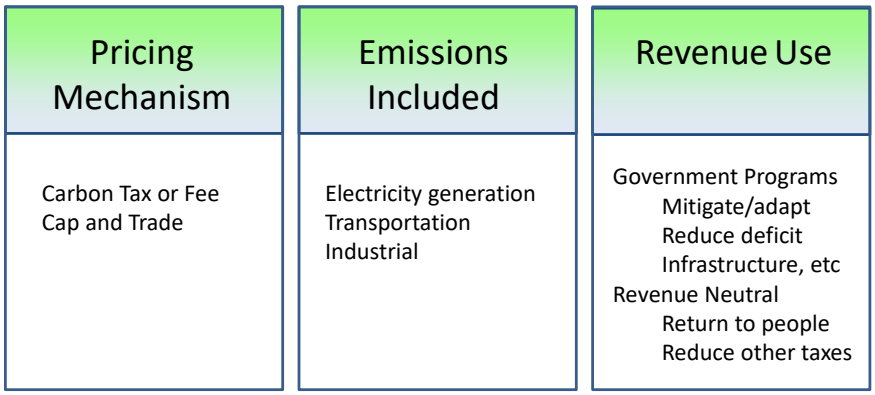
Reducing greenhouse gas emissions to slow climate change is an increasingly accepted goal. Since 75-80% of greenhouse gas emissions are from fossil fuels, putting a price on carbon emissions is considered a good approach – and it is cheaper than other alternatives. A price on carbon will put the market to work to decrease demand for fossil fuels and make alternatives more affordable. Carbon pricing is not a new idea, but it is an idea that is now growing very rapidly.

Carbon pricing, with the goal of reducing carbon emissions, was first established in the early 1990s with carbon taxes in Scandinavia. The first large cap and trade system was in the European Union beginning in 2005. The EU system had some early problems with low prices, but now in Phase 3, has built on learnings from earlier attempts. Since 2012 a number of schemes have nearly doubled the global emissions covered by a price on carbon. This will nearly triple when China introduces a national cap and trade system in 2017, bringing global emissions covered to 33%.

How Do You Price Carbon?

There are three primary elements to any pricing scheme: 1) the pricing mechanism (cap and trade or carbon tax or fee), 2) the emission sources included, and 3) how the revenue is used (Figure 1).

Figure 1. Carbon Pricing Elements



Pricing Mechanisms

The pricing mechanism used to put a price on carbon emissions can be either a Cap and Trade system or a Carbon Tax. The essential difference between the two methods is where the government control is set and where the market control is set, as shown in ***Figure 2*** on the right. Hybrid models using elements of both are also possible.

	Cap and Trade	Carbon Tax
Emissions	Declining emissions cap set by government	Emissions volume based on market
Price	Price based on market	Rising price set by government

Cap and Trade: In cap and trade, a cap on carbon emissions is set by the government on various parts of the economy, such as power plants, manufacturing, and/or transportation. The cap is based on previous emissions (the baseline) and declines over time. Each emitter must have permits sufficient to cover their emissions. These permits — or "allowances" — are typically sold at auction by the government. If a company does not have sufficient permits for their emissions, they can buy permits on the open market from those who have more permits than they need. Thus the emissions levels are set by the government, and the eventual price is set by the market.

Sometimes free permits are given by governments to "preferred" industries, which skew the market and make cap and trade less effective. That was a key problem in early application of the EU cap and trade system.

Carbon Tax: Like it sounds, a carbon tax (or fee) is a price on carbon emissions set by the government. It can start low but must ramp up with time. With a carbon tax, emissions would be a cost to a business, and those businesses would attempt to minimize those costs, thereby causing a decline in emissions coincident with that cost reduction. Like allowances, or free permits, in cap and trade, tax breaks could give advantages to some businesses. To allow the market to truly pick winners and losers, such advantages should be avoided.

Carbon Tax vs. Cap and Trade: Much has been written debating which is "better" — carbon tax or cap and trade. The essential difference is simply whether government controls the price or the level of emissions as shown in Figure 2.

Cap and trade will assure that we reach our emissions target, which is a key objective to limit climate change. But a carbon tax will also reduce emissions through the market. A carbon tax is simpler to administer, but requires that the tax be high enough to affect emissions, and further, typically needs to start low and increase over time. Setting a tax which is high and increasing is politically difficult.

Also, as argued by Alice Lépissier and Owen Barder in a 2014 economic paper, "… we don't necessarily know the right price to set on carbon. Setting it too high could have large economic costs and setting it too low would lead to potentially irreversible climate change. Given that our key underlying objective is to limit

the volume of carbon emissions, then we should set the quantity and let the market take care of setting the price. That is the simplified case for cap-and-trade."

Cap and trade in large trading systems allows for economic leveling of prices across borders. Two such large systems are the EU Emission Trading System (cap and trade), and the Western Climate Initiative, a trade group of California, Quebec and, Ontario, possibly extending to include Washington, Mexico, Colombia and Chile. A national or international carbon tax could be used for a similar leveling across borders.

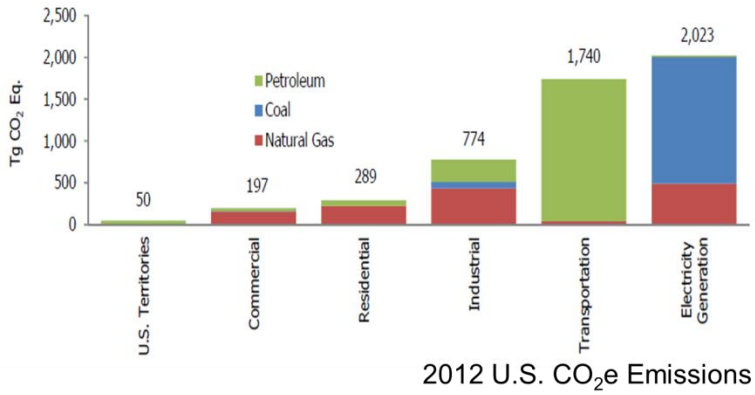
Another point for discussion is the inefficiency and basic lack of fairness in either system of allocating allowances (free permits) to some companies in cap and trade, or similarly allowing tax breaks in administering a carbon tax. The practice gives unfair advantage to those companies and their shareholders (which disadvantages those with lower incomes who don't usually invest) and skews the free market. The over allocation of allowances at the beginning of the EU ETS is often pointed to as one reason the system initially floundered. The many negative points surrounding free allocations are reviewed eloquently in 2009 testimony to the Senate Finance Committee by a number of experts.

Either system can return revenue to the households and businesses or use the revenue to support government programs for mitigation or adaptation to climate change. Either system can include all or only some emissions. Beyond which system is the best fit, we need to also consider what emissions are included and how the revenue is controlled and used (see Figure 1).

Emissions Included

Ideally, to control carbon emission using a price on carbon, all emission sources should be included. The primary emission sources in the U.S. in 2012, as plotted by the EPA, are shown in ***Figure 4*** below.

The three primary sources are electricity generation, transportation and industrial. Some pricing schemes, like the Regional Greenhouse Gas Initiative (RGGI), apply only to power generation, which covers 20% of total emissions; by contrast, the California cap and trade was extended in 2015 to include transportation and now covers 85% of emissions. Most global pricing schemes include power generation and industrial, but only a few include transportation (California, Quebec, New Zealand, Kazakhstan, and Shanghai).



Tg (teragrams = 10 million tonnes)
CO_2e includes other greenhouse gases such as methane, nitrous oxide, and fluorochemicals

Revenue Use

Determining options for the use of the revenue generated by the two principal pricing mechanisms is where the rubber meets the road. The options range from revenue used for government programs for mitigation of or adaption to climate change, such as we see in California, to "revenue neutral" such as we see in British Columbia where revenues are returned to the Canadians through cuts in other taxes.

Revenue Neutral

Revenue neutral means all revenues that accrue to the government from a pricing system are returned to households and/or businesses through some mechanism, like tax cuts or direct dividends. That's where the simplicity ends, though. Should the cuts include corporate taxes? income taxes? payroll tax? social security tax? And how should the amount be determined? Proportionate to the amount paid? a flat fee? If a flat fee, should the money be distributed to all citizens? to all taxpayers? to all households?

In considering these variables, we need to consider what behaviors we want to reward and the many possible unintended consequences. Also we must keep in mind that the revenue will decrease with time as emissions decrease. We need a careful assessment of how the government budget will play out as carbon emissions, and therefore revenues, decrease.

Other Revenue Uses

Other ways to distribute revenue include: reducing the deficit, investing in specific programs like infrastructure, reducing payroll or labor income taxes, reducing capital taxes, corporate income taxes or capital gains tax, giving revenue to states or other sub-federal level entities, or aiding communities most affected by fossil fuel emissions or climate change.

Research

One critical investment that must be made is in research – research on alternative fuels, distributed capture (forestry, agriculture and geologic processes), energy efficiency, alternative energy sources, and land use planning, batteries, and so on. But also it is imperative that we invest in basic research on how the climate system works, glaciology, oceanography, biochemistry, and much more.

Summary

Economists argue that putting a price on carbon emissions is the least expensive and fastest way to see real decreases in carbon emissions. There are three principal elements of carbon pricing: the pricing mechanism, the emissions covered, and how the revenue is used. Both pricing mechanisms – cap and trade or carbon tax, or hybrids of them – have been used and can be successful. There are advantages and disadvantages to the many different combinations of pricing, emissions covered and how the revenue is used. For best effect of any of the systems, the market should be kept as fair and free as possible.