



It is a stark and frightening fact that, despite more than two decades of international effort — including enormous time and energy expended on the Kyoto Protocol — and significant economic costs, carbon emissions are now rising even faster than they were in 1990. Back then they were going up by about 1.5 parts per million (ppm) per year. Now it is 2 ppm. The critical 400 ppm global threshold will shortly be crossed, and there is little reason to believe that this trend is likely to be halted any time soon.

This raises two obvious questions. How could so much effort lead to so little result, and how could so much political capital and economic cost be expended to so little effect? The second follows from the first: Given that current approaches have so lamentably failed, what new directions do we need to take if climate change is to be cracked?

The obvious place to start is with the causes of these emissions. The answers are straightforward: Coal has been the big winner in meeting the growth of energy demand since 1990, particularly for electricity generation. It has increased from around 25 percent of world primary energy demand to nearly 30 percent — a rising percentage on a sharply growing underlying demand. Much of that extra coal has been burned in China, and despite moves to reduce coal's share of electricity generation, China is going to burn a lot more over the rest of this decade. China and India together currently add around three new coal stations a week, and between now and 2020 around 400 to 600 gigawatts of new coal is likely to come onto the world's energy systems.

But before we get carried away blaming China, it is important to work out why this increase has taken place. China's phenomenal economic growth has been based on exports, notably of energy-intensive goods, from steel and petrochemicals to a host of manufactured products. These have been bought largely by the U.S. and Europe, which together account for nearly 50 percent of world GDP.

It is carbon consumption that measures the carbon footprint and hence responsibility, not the carbon production in particular geographical areas. Yet remarkably the Kyoto framework does not take consumption into account. Instead it focuses on carbon production, and mostly in Europe, where deindustrialization and the collapse of the former Soviet Union make compliance with the targets easy. For example, the UK's carbon production fell by more than 15 percent between 1990 and 2005, but once imported carbon is taken into account, carbon consumption went up more than 19 percent. This explains how carbon production can be falling in Europe in line with its Kyoto targets, while global carbon emissions keep going up.

This sadly is not the only fault line in the Kyoto-style approach. It is riddled with free rider problems — in which some nations reduce emissions while others do nothing — and it does not target the countries where the emissions really matter. No wonder the U.S. kept out. Indeed it is a miracle that the Kyoto Framework could even hold itself together at the Durban climate conference in December 2011. The price was inaction: All that could be agreed was that the parties would try to agree by 2015 what might happen after 2020. By that time, all those new coal power stations will have been built and atmospheric concentrations of CO₂ will be well above 400ppm. The upcoming summit in Doha, Qatar, will not make much difference to this timetable.

It is time to recognize that while talking is usually a good idea, the fabric of Kyoto is not going to head off climate change. So the answer to our first question — why there has been no dent in emissions? — leads to the second: What would we need to do to make such a dent?

There are three parts to the answer. The first two are related. Unless people pay the cost of their pollution, they will not do much about it. And that pollution is best measured by carbon consumption, not carbon production. Therefore there has to be a price (a tax) on carbon consumption — a carbon tax with border adjustments to ensure that imports of carbon-intensive goods from countries without a carbon price are treated on the same basis as domestic production.

Immediately howls of political protest will be heard. Politicians do not like carbon taxes, because they fear we the voters will chuck them out if they dare to make us pay for our pollution. Carbon border taxes are claimed to be protectionist, interfering with world trade. Yet a moment's reflection tells us something quite profound: If we don't want to pay for the pollution we cause, we don't really want to address climate change, since a carbon price is almost certainly cheaper than the alternatives of command-and-control and detailed government intervention. Setting

specific pollution controls on large industrial installations, picking "winners" among technologies, setting quotas, and targeting subsidies to influence investment decisions are all open to interference by lobbyists seeking to profit from the interventions.

So if climate change is to be dealt with, there is no real alternative but to face down the critics of carbon pricing. Whether politicians rise to the challenge remains to be seen. Yet a combination of the need for new sources of revenue, coupled with the piecemeal emergence across a number of countries of some form of carbon pricing, suggest some limited grounds for optimism.

Not to have a carbon price is an export subsidy and hence a distortion to trade. Making sure we have a level carbon-pricing field is pro-trade and enhances efficiency. It might of course be complex, but it turns out that a small number of large, energy-intensive industries make up the bulk of the carbon trade and so in practice it will not require much to make a big difference to the outcome. It is better to be roughly right, than precisely wrong.

A carbon consumption tax would comprise two elements — a domestic tax on carbon, and a tax on carbon imports. There are a variety of ways of approximating the domestic dimension, from upstream taxes at the point of extraction, to downstream taxes on enterprises or consumers. Externally, the border tax could start with steel, aluminium, petrochemicals, and fertilizers, and then be gradually expanded. The added attraction is that this can be done bottom-up: Countries can do this individually, rather than wait for an international agreement. In other words, it gets around the free-rider problem facing countries that want to be early movers. They can act without disadvantaging their own industries.

A carbon price signals to both the demand and supply sides of the market, and gives a long-term signal to investors. Its immediate effect, however, is almost all on the relative economic costs of coal and gas, making coal proportionately more expensive. In Europe a pathetically low, volatile and short-term carbon price generated through the EU's Emissions Trading Scheme has had no significant impact, and indeed it has allowed a major dash from nuclear to coal and from gas to coal. Germany leads the way — it is burning more coal in its existing coal power stations and it is adding new lignite coal stations.

The immediate priority is to deal with this coal problem. Coal is really dirty stuff. It kills lots of miners — several thousand a year in China, for example. Coal mines leak methane, they pollute the water table with heavy metals, and it takes a lot of energy to dig out the coal and transport it to power stations, which then emit not just carbon but other major pollutants. Coal-fired power

plants use lots of water for cooling and the ash needs to be disposed of.

Gas provides a temporary stopgap, with half the carbon footprint of coal and few of the other pollutants. In the U.S., with little or no energy or climate policy, shale gas is making major inroads into coal, resulting in some of the biggest drops in emissions in the developed economies, outside the Kyoto agreement. In Europe, by contrast, governments (notably France) have been banning shale gas, on the grounds that it might lead to methane leakage and water table contamination. These are real problems that need regulating, but a moment's reflection should lead to the conclusion that if shale gas is to be banned, then all coal mining should be illegal, too. Yet in Europe the shackles being placed on gas mean yet more coal is being burned.

Gas is a temporary fix, and unless there is some massive success with carbon capture and storage it will eventually need to be phased out, too, in a decarbonized world. This brings us to renewables. It is a sad fact that none of the current renewables are capable of bridging the gap toward decarbonization. Wind, conventional rooftop solar, and various biofuels and biomasses require areas of land and water resources that are simply impossible to provide. It takes an enormous number of intermittent wind turbines, at best a few megawatts each, to deliver the output of a conventional power station. It takes a lot of roofs and more agricultural land than currently in total use in the U.S. and Europe to make much inroads into car fuels.

Yet it is these current renewables where all the effort — and money — is going. Europe in particular is determined to meet the short-term renewables and biofuels targets by 2020, spending billions on offshore wind and rooftop solar. Not only does this undermine Europe's competitiveness against the shale gas-powered U.S., but it means that the money is not available to spend on future renewables and all the new technologies that might just crack climate change. These include next-generation solar, which involves improving the chronic inefficiency of existing solar panels, in particular through the infrared part of the spectrum, and a host of new materials to capture solar energy. Then there is solar thermal; artificial photosynthesis; geothermal, still in its infancy; next-generation nuclear; and a number of ancillary transformational technologies like smart grids and meters, which influence demand, and batteries and storage, which might solve the inherent storage problem that has long bedeviled the electricity industry.

Current renewables cannot bridge the gap, so either it's climate change or it's new technologies. Yet if, in the meantime, a serious carbon price can be introduced based upon carbon consumption and we can get off the coal escalator into gas quickly, then there is a hope that the 500 ppm threshold will not be crossed by 2050. But carrying on as we are, hoping Kyoto will

solve the problem, is worse than wishful thinking: It carries lots of cost for almost no benefits.