Technology, Behavioural Change and a Carbon Tax are needed to Address the Climate Change Problem

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Abstract

This paper considers three alternate approaches to solving the problem of climate change by reducing greenhouse emissions. It then considers some of the core science on climate change drawing on the Stern report in the UK, the Garnaut review in Australia and the Intergovernmental Panel on Climate Change Fourth Report. It considers the role of production externalities in creating the build-up of 'greenhouse gases' and the related problem of 'market failures'. It is argued that the European Union Emissions Trading Scheme is an example of the failure of an ETS in a sophisticated environment where there were both market failures and government failures.

The rest of the paper is concerned with some of the design features of a carbon tax and how such a system could be used in both developing and developed countries, where it would generate additional government revenue which could be used to compensate low income families for the additional costs of greenhouse gas abatement and also used to encourage the development of 'green energy'. It concludes with a list of some of the main advantages of a carbon tax system over an ETS.

Introduction

As Benjamin Franklin once said “In this world nothing is certain but death and taxes” and the climate change issue has become such a pressing issue that we are now facing a stark choice between the premature death of hundreds of millions of the people of this planet (from storm, flood, starvation, war or pestilence) and the use of taxation to change the relative cost of carbon intensive sources of energy compared to the cost of ‘green’ sources of energy. As all economists know, it is possible to influence the price of a commodity or its quantity, but not both. Management of prices is the best way to manage the quantity demanded and supplied and the climate change issue is now such an urgent one that we need an approach that has an immediate impact upon the relative price of carbon generating activities. This would aim to reduce the current subsidy to those fuels which are produced in such a way as to externalize many of their costs of production and gain a market advantage over those (renewable) energy sources which bear the full cost of production which most of the ‘green’ fuel alternatives to carbon based fuels are forced to accept. For over 200 years we have had pollution from a range of industries which have never born the full cost of their production in the greatest example of ‘market failure’ ever witnessed and we need an immediate solution to this problem which can only come from a carbon tax. Reliance on ‘the market’ through a ‘cap and trade’ system to solve the greatest ‘market failure’ ever seen is the triumph of hope over experience.

The two alternative approaches to a carbon tax, of an agreed emissions target and a ‘cap and trade’ system, can both contribute to a solution but both would have a slower and less certain impact and both have been tried and failed. The Kyoto agreement is the best known example of agreed emissions targets and all the evidence available to date indicates that most countries will not meet their targets because of the need to sustain and grow economic activity in the relevant treaty country, the immediate needs of economic growth seem to push the less immediate need to restrict greenhouse gas pollution into the background and the treaty sanctions will be hard to enforce against any sovereign country that does not wish to comply. Without some price signal an emissions target on its own is doomed to failure because the alternative economic imperative of growth will always overwhelm the good intentions expressed in the agreed target. The European Union ‘cap and trade’ system is the best known example of such an approach and the current evidence is of compliance problems which have destroyed the integrity of the first attempt to operate this system. Though a second phase of the European system has now started and it will be interesting to see whether the EU has learned from past failures and has designed the new phase of their ‘cap and trade’ system with more attention to the likelihood of national self-interest which had destroyed the integrity of the first attempt to operate a ‘cap and trade’ system.

In economic terms there is little difference between a carbon tax and a price for carbon set by the market in a 'cap and trade' system.

"The essential differences between a well-designed and credible ETS (Emissions Trading Scheme) and a well-designed and credible carbon tax are not as large as is often supposed. Many economists prefer a carbon tax because they hold the view that the alternative is not a well-designed and credible ETS, but a distorted one, surrounded by uncertainty about key parameters. It could be said that they have experience to date from the established carbon ETS schemes on their side"[i]

A View of the Science from the Fourth IPCC Report

The most recent report of the Intergovernmental Panel on Climate Change (IPCC WG1 AR4) contains a great deal of material on the composition of the atmosphere and changes in its composition over time. It provides a useful Historical Overview of Climate Change Science in chapter 1 which starts with the work of Charles Keeling in 1958. This is said to provide "the master time series documenting the changing composition of the atmosphere" [ii](p 100) which was compiled with meticulous accuracy and precision. It also documents the analysis of air bubbles contained in ice cores from Greenland and Antarctica to provide a much longer period of analysis. It is not just carbon that is the problem as further atmospheric measurements made since 1970 (Steele et al, 1996) report significant increases in two other major greenhouse gases, methane and nitrous oxide[iii]. A summary of the human fingerprint on greenhouse gases indicates that: "At the time of the TAR (Third Assessment Report) scientists could say that the abundances of all the well-mixed greenhouse gases during the 1990s were greater than at any time during the last half-million years (Petit et al, 1999) and this record now extends back nearly one million years."[iv](IPCC WG1 AR4, p100).

Further, in summarizing the relationship between climate change and weather the IPCC report:
"While many factors continue to influence climate, scientists have determined that human activities have become a dominant force, and are responsible for most of the warming observed over the last 50 years. Human-caused climate change has resulted primarily from changes in the amounts of greenhouse gases in the atmosphere, but also from changes in small particles (aerosols), as well as from changes in land use." [v]

Some of the major findings of the IPCC 4th Report can be summarized as:
1. Global temperatures have risen by 0.74°C (±0.18°) in the last 100 years,
2. Eleven of the last twelve years rank among the hottest twelve years ever recorded,
3. Snow cover has decreased in most regions, especially in Spring and Summer,
4. The Summer period has extended by 12.4 days,
5. An Arctic sea-ice decline of 2.7% (±0.6%) per decade,

6. Sea levels have risen by 1.9mm (±0.5mm) per year in the period 1961-2003.

This is a serious list of some of the changes which appear to have occurred over the last 100 years, largely as a result of anthropogenic activities related to the expansion of industrial society. Of course it must be acknowledged that climate science is an uncertain activity and the climatic system is very complex and changes in it are hard to measure. But there has been a continuing build-up of scientific research over the last 100 years which cumulatively add up to a serious picture of a phenomenon which has developed quickly and this phenomenon could lead to disastrous consequences for hundreds of millions of people. There seems to be a sort of consensus which has developed around the idea that a global temperature increase of more than 2°C could lead to a runaway greenhouse effect which will be impossible to control. But if we accept warming of 2°C as the benchmark we are accepting the inevitability of climate change and Hurricane Katrina is a good example of what can occur on a mildly warmed planet. We are accepting the inevitability of a much more volatile climate than we have experienced, and if we do nothing but continue with 'business as usual' then the planet is set on an unknown path towards unprecedented warming which is likely to cause severe storms, ecosystem destruction and the creation of large numbers of environmental refugees who will be forced to move from low-lying coastal areas, with disruptive effects that are unimaginable.

The Stern Report indicates that before the industrial revolution greenhouse gases in the atmosphere were 280 parts per million (ppm), the current level is 385 ppm, and it is recommended that the level should not rise above a range of 450-550 ppm, as any level above this range would greatly increase the risk of very harmful impacts such as crop failures, water shortages, flooding and cyclonic weather events. The IPCC have analysed the climate impacts for a whole range of greenhouse gas emission scenarios ranging from the 'business as usual' scenario to a scenario where there are drastic emissions reductions, business invests heavily in a carbon-limited economy, new technologies are born, greenhouse gases are stabilized at around the level of today and the planet experiences only moderate climate change. But whatever we do the world faces some climate change from the existing build-up of greenhouse gases in the atmosphere.

To consider the extreme case look at the planets in our solar system. The planet closest to the Sun is Mercury. But it is not the hottest, the hottest planet is Venus and this is where we see the full impact of a runaway greenhouse effect. We are a long way from this, but we need to act now to stop the current progress towards this possible future.

Current and Future Technology

There are a range of proposals to reduce the level of greenhouse gases which are added to the atmosphere and the science suggests the need for developed

countries to reduce the level of such impositions upon the atmosphere by 25-40% from 1990 levels by the year 2020 with a long-run reduction of at least 60% by 2050. As the world is proceeding down a path which is much worse than the worst-case path considered by the IPCC (because of the energy demands of the large developing economies) then urgent action is required to address the continuing accumulation of greenhouse gases and it could be useful to consider the current and foreseeable technologies that are available to address these targets.

The EU seems committed to a major reduction in greenhouse gas extrusions by 2020 as they have the tightest emission control standards and the most significant ETS in the world, also they appear to have started on a program of energy conservation which has the potential to achieve a 30% cut (from 1990 levels) by 2020 through a program of improving energy efficiency and reducing demand for energy. Such a program would be of very low cost and perhaps even of benefit to consumers who learned to conserve energy. But how could this be achieved in a coal-dependent society like Australia, where as much as 90% of our electricity comes from coal-fired power stations in some states and others use highly inefficient brown coal in their power stations?

It is important to consider the task in two stages, the 2020 target and the 2050 target, as we have a range of technologies available that could cut developed country emissions by 30% or more by 2020 and there are other technologies (such as carbon capture and sequestration, ‘hot rocks’, solar thermal or nuclear power) which could contribute to a much higher reduction in emissions by 2050, but this developmental suite of technologies would be costly, whereas the available technology could greatly reduce emissions at very low or nil cost.

Available technology includes wind, tidal and solar energy, but also the transfer of stationary power generating activities from, high polluting, coal to much more efficient gas. To take a key example, which is consistent with the second law of thermodynamics, brown coal is only 60% as efficient as black coal in generating electricity. The loss of energy through entropy is such that Victoria’s brown coal fired power plants generate some 50% more greenhouse gas per megawatt hour than do NSW’ most efficient black coal fired plants and gas is even more efficient, with a carbon cost only around half that of coal. Further, recent figures from Victoria indicate that 59% of its pollution came from coal, with 27% from petroleum and only 14% from natural gas. A move to the use of gas in stationary power stations could reduce the level of Greenhouse gas pollution by a significant part of the 30% reduction required by 2020.

It would be possible to gradually increase the use of renewable power, supported by gas to provide the base load power that is needed. All the criticisms of renewable energy are based on the base load power fallacy, the argument that they are a weather dependant source of energy which is unpredictable and so unreliable that they cannot provide base load power. This has some validity in a

situation where all the power was drawn from one small geographic area and one renewable source, but it has no validity in a large country like Australia where it is possible to site wind farms in more than 100 spots and where the wind will always be blowing somewhere, this is especially so as the wind power can be supplemented by tidal, solar thermal, geothermal or gas power all of which generate low or nil quantities of greenhouse gases.

There are also the issues of energy conservation and efficient use of energy. It is clear that by burning coal we do not get the amount of energy that we pay for, it is estimated that the loss of energy through entropy in burning black coal to produce electricity is around 70% and this is closer to 80% when brown coal is burnt. It is also clear that it is cheaper to store hot water from solar thermal systems than it is to store electricity, so again we could generate base load power from a solar thermal system more cheaply than we could provide some sort of battery storage back-up for a coal-fired power station (which could fail for a number of reasons and so could be classed as inappropriate to provide base load power). The energy efficiency argument compares coal based power, which externalizes most of its costs to the community through pollution, with other sources of energy which can compete on a cost basis if coal bore the full cost of its production including the cost of its pollution. The basic requirement is for governments around the world to address the cost issue by forcing coal to bear the full cost of its conversion into energy and this can be easily achieved by imposing a carbon tax upon dirty coal which forces coal producers to bear the full cost of their production activities.

It should also be possible to encourage individual energy consumers to conserve energy in the home, which would save domestic costs and remove the need for more polluting power stations. The banning of certain light globes and storage hot water systems is a start, but a campaign of persuasion which encourages people to do without air conditioning except on extreme days, encourages people to turn off electric appliances at the switch rather than leaving them on standby and which discourages the use of inefficient second refrigerators could also cut greenhouse gas extrusions significantly. This could be associated with a campaign in favour of diesel or hybrid cars and a ban on all household appliances with low energy efficiency which could achieve a great deal in the move to cut emissions by 30% by 2020. A combination of some or all of these measures could achieve the 30% cut at little cost to individuals. Further, if the money from a carbon tax was collected as a hypothecated source of revenue which was solely to be used to reduce the cost of solar hot water and other energy saving devices then this money could be used to remove the cost increase from lower income groups through targeted rebates granted on a means-tested basis for all lower income people who investment in energy saving devices.

This brings us to coal, which could be removed as an energy source in a developed country like Australia with its plentiful wind, tidal, solar and geothermal

energy sources, but which remains the basic source of energy in the developing world for the foreseeable future. The longer term objective must be to make coal consumption cleaner than it currently is and ultimately this will require the development of carbon sequestration technology. The technology for capturing carbon from coal and oil already exists, it is used in the oil industry to drive extra oil from old oil wells, but it has only been used on a small scale and in a limited context. The EU has a number of small-scale demonstration plants which are to be used to develop the technology and to prove its viability and the USA has a heavy investment in a similar plants (though this has recently been suspended), but the carbon storage problem will remain a core concern, and it is possible that storage in saline aquifers may be impossible for some countries and regions. We should not forget the catastrophe that occurred in Cameroon in 1986 at Lake Nyos, where a CO2 bubble escaped from the lake and killed some 1700 people and a similar event had occurred at Lake Monoun two years earlier which killed 37 people. This is a warning of the need to select the relevant carbon storage sites with great care and of the consequences of any storage failure.

The European Union Emissions Trading Scheme (EU ETS)

In January 2005 the European Union Greenhouse Gas Emissions Trading Scheme (EU ETS) commenced operation as the largest multi-country, multi-sector greenhouse gas emissions trading scheme worldwide. In the first phase of the scheme a limited number and type of installation was to be involved and it was to be restricted to the monitoring and control of CO2 only. Some 12,000 installations covering energy activities, production and processing of ferrous metals, the mineral industry and pulp, paper and board activities were covered by Phase 1 of the EU ETS.

Under the EU ETS the specified large emitters of greenhouse gases must monitor and report their CO2 emissions. In order to ensure that real reductions in CO2 emissions occurred EU governments were to ensure that the total amount of allowances issued to installations was less than the amount of CO2 that would have been emitted under a predicted scenario of normal business operations. Each member state was able to allocate a quantity of certificates as set down in the Member State National Allocation Plan.

The scheme allows a regulated entity to use a carbon credit to comply with its obligations to return an amount of emissions allowances to the government which is equivalent to the amount of the installation’s emissions into the atmosphere during the year. The installations subject to this scheme may get the allowances free from their government, and it was expected that the various governments would offer credits equivalent to 95% of expected emissions, with trading in the other 5% of emissions. Installations were expected to purchase extra credits from other installations or traders and to be able to sell any excess allowances that they accumulated to anybody on the open market. A regulated entity could acquire carbon credits from any carbon reduction project that was

certified as eligible to issue carbon credits by the host government or the Clean Development Mechanism Executive Board of the EU.

Experience over the past few years has shown that European governments allowed their industries as much carbon dioxide as they could emit at little or no cost. Recently released data from the European Commission shows that most member states granted their industries carbon emission allowances which were far too generous in the period 2005-07, and that this resulted in the virtual collapse of the carbon market in 2007. Publishes figures now show that actual emissions from installations covered by the EU ETS in 2005 were several million tonnes below the granted permits. This has distorted the market and undermined the credibility of the emissions trading scheme.

The European Union emissions trading scheme began on 1 January 2005 and in its first year of operation some 360 million tonnes of CO2 were traded for a total sum of 7.2 billion Euros. During the first year the price of emissions increased steadily to reach a peak of 30 Euros per tonne in April 2006, but this price began to fall rapidly soon after as it became clear that many countries had given their industries such generous emission caps that industry did not need to reduce emissions. This created a crisis of confidence in the scheme and CO2 prices fell rapidly over the next year to a trading price of 1.2 Euros per tonne in March 2007. The price eventually declined to 0.10 Euros per tonne by September 2007, which discredited the market and caused calls from many NGOs for more stringent restrictions on CO2 and tighter allocations of emission credits in the next phase of the scheme.

The second phase of the EU scheme has begun and they are confident of not repeating the mistakes of the first phase. The allowances are said to be tighter and the scheme will include more greenhouse polluters, including the airline industry. At the start fo this phase it appears that December 2008 futures contracts for permits, which are known as European Union Allowances (EUA), were trading at around 24 Euros and that a secondary market developed, whereby a financial intermediary will accept the risk of guaranteed delivery of a EUA for a price around 18 Euros. It is clear that a profitable industry may develop around the acquisition and sale of permits and a number of exotic financial instruments have been developed to facilitate this, but the profits from this activity will go to traders and entrepreneurs who use the system to make money while having no commitment to greenhouse gas reductions and this may drain resources from the greenhouse gas abatement activity. It also means that there will not be enough money to compensate lower income groups for the cost of their contribution to greenhouse gas abatement. Further during the period December 2008 to January 2009 the price of an EUA fell well below 10 Euros because of the lack of liquidity in the market associated with the Global Financial Crisis, again indicating the volatility of the market and that prices could be driven by factors outside the issue of dealing with climate change.

Market Failure

The whole greenhouse gas problem arises from a dramatic case of market failure, where for the past 200 years or more of the industrial revolution firms have not met the full cost of their production and have imposed significant costs arising from pollution upon society generally, and there has never been a comprehensive attempt to measure these costs. The idea of a 'cap and trade market' (a form of ETS) for carbon and other greenhouse gases is based upon the idea that markets are the best way of allocating resources yet developed and that markets tend to operate efficiently in the allocation of scarce resources. In general this idea has been supported empirically in many market settings and financial markets are the best current example of efficient markets in certain limited conditions and in the medium term. But financial markets have shown a clear tendency to over-react to any stimulus in the short run, though large capital markets do tend to operate efficiently in the allocation of resources and as price setters in the longer term. Basically capital markets deal in intangibles, as the intrinsic value of a security is the present value of its expected future cash flows (a set of expectations) and in this sense they can be compared with a market for greenhouse gas emissions which also deals in intangibles and which will set prices based upon expectations about the supply and demand for carbon emissions credits.

But the current problem is the result of a dramatic case of market failure, where industrial organizations have failed to bear the full cost of their production by passing the costs of their pollution onto the community wherever possible. The cost of business has always been understated because of this and it is not clear that a market-based solution is the best way to deal with an existing market failure. There are many sources of market failure and many of these problems would be evident in a cap and trade market for carbon emissions.

The idea of market efficiency is closely related to the economic theory of perfect competition which requires a large number of buyers and sellers, homogeneous production with all firms selling an identical product or ones that are fully interchangeable, for all buyers and sellers to have complete information about prices, market conditions and available technologies and that there are no barriers to firms entering or leaving the market. These are not generally characteristics of markets, though financial markets have some of these characteristics.

In one of the best and most comprehensive expositions of the theory of market operations published in the 1995 edition of the Asian Development Bank's 'Asian Development Outlook' it was suggested that a perfect market has a number of additional features which are necessary for its operation. These are that there are no external effects so that all parties bear the full cost and receive the full benefits of their production and consumption, there should be no unexploited economies of scale, all parties must know their own best interests and there

should be no uncertainties or ambiguities. These criteria are not features of any market that exists at the moment and they raise questions about the capacity of any market to operate in an ideal manner.

Where one or more of these essential assumptions of market perfection are absent then a real world market will fail to achieve the efficiency that a perfect market promises to deliver. Given that we have never had a market that meets all the above criteria and also that the greenhouse problem is a result of market failure it may be useful to consider the main causes of market failure.

1. Information Problems

Many of the problems with market behaviour arise because of unequal access to information. The insider trading problem is a direct result of asymmetric information access, where a person is able to make super profits from a market transaction because they have information which other market participants do not have. In such a case the informed participant can make profits at the expense of other market participants and this will produce sub-optimal market outcomes.

Incomplete information and information uncertainty are further aspects of the general problem because an efficient or perfect market requires complete, unbiased and certain information. Any market participants who have some information or information that they are uncertain about will make sub-optimal decisions and this will also reduce the overall efficiency of the market as an allocator of scarce resources. Information problems are at the heart of the failure of the first phase of the EU ‘cap and trade’ system as big profits were made by some market participants who became aware of the faults in the system, while other market participants lost large amounts of money because they were not as well informed as the ‘insider’ group.

2. Market Power

An efficient market requires a large number of informed buyers and sellers who are able to compete on price and quantity terms in the market. If there is only one producer in the market (monopoly) or a few producers (oligopoly) then there will be attempts to extract super profits by setting prices higher than in a competitive market and there will be less production as a result of this, a major source of market inefficiency.

The evidence from the EU is that many of the states that participated in the system used their ‘market power’, both political and economic, to extract a better deal for firms operating within their borders compared to other firms who operated in smaller states. Also, the system was characterized by the inclusion of some industries in the carbon limits imposed while others were excluded and only some greenhouse gases were included in the limits imposed by the system

with methane and nitrous oxide being excluded, despite the fact that both of these gases are more damaging to the atmosphere than carbon.

3. Externality Effects

The whole greenhouse problem stems from the failure of Western industry to pay the full cost of their production since the industrial revolution, costs of pollution were ‘externalised’ wherever possible by industry and born by members of the wider community. This has resulted in the costs recognized as part of product prices being less than full the cost of production to the community. In turn this has resulted in more production than was necessary because of the lower price of commodities and heavier exploitation of the scarce resources available on the planet. An obvious example of the problems caused by this is the problem of ‘peak oil’, where the current shortage in the supply of oil relative to demand has driven the oil price to unprecedented levels. This has driven a search for oil to exploit the higher prices but only very limited success in locating new supplies and a current view that there will be no more large oil discoveries, the resource has been exploited to the point of extinction within a few years.

The externalities caused by overproduction also show up in the massive deforestation and species extinction that has occurred over the last forty years as more and more effort has been expended on the exploitation of our natural resources. Certainly those that are planting palm oil plantations in place of the great forests of Kalimantan are not paying the full cost of the resources (forests) destroyed in making super profits from the plantations while the local inhabitants receive only a small return for the massive destruction of the natural environment.

4. Public Goods

The environment is the classic ‘public good’ in that it is not the exclusive property of any one person or group, thus, a large number of people enjoy the benefit even though they have not paid for it. It is consumed by many people without any need for them to compete with one another for the benefit and at nil or little cost to the user. Where there is no economic benefit to a supplier the market will normally tend to under-supply the goods, but this is not the problem with the environment.

Because there is no cost and there has been an apparent abundance of air and water to consume at no cost there has been massive over-consumption of the environment. Over the past 200 years since the industrial revolution Western industry has polluted rivers and air with little or no regard for the long-term consequences of this. There has been massive degradation of land, rivers and air over the last 200 years which we are now finding to be unsustainable.

5. Economies of Scale

Generally if firms are not producing at an appropriate volume to exploit economies of scale then their activities will not achieve allocative efficiency. This issue is directly relevant to the relative cost of participation in a ‘cap and trade’ system as the costs born by smaller firms will be proportionately higher than those of large firms with the systems and personnel in place to manage participation in the market for carbon credits.

6. The ‘second best’ Problem

Any market failure in one market will compound the inefficiencies present in any other related market because all markets are interrelated. We are talking about correcting a distortion in one market by a system of indirect influences on the price of a commodity in the trade for carbon credits. Those who can bear the cost of some budget limit on their output of carbon will be able to trade carbon credits to those with relatively higher cost structures in a perfect market adjustment which assumes perfect knowledge and a capacity to move production activities to take advantage of the relative cost of carbon. But the actual cost of carbon will not be known in advance in a market where credits are traded, so the efficient operators will not know the actual cost of adjustment to production activities and the cost savings if they move from using coal to using gas or solar or wind power, producing a ‘second best’ outcome.

7. The ‘free-rider’ Problem

Wherever there is dealing in a public good, such as the atmosphere, there will be ‘free-riders’, as we have seen in past attempts to address environmental pollution by business. Many firms are currently subject to restrictions on their pollution activities by direct government limitation upon their activities and requirements to add pollution control devices to chimneys and other sources of pollution if they are located near a city or subject to the attention of a lobby group. Though other firms still receive a free ride by virtue of their location, where it is out of sight of people affected by the activity or where it is able to lobby government for special protection because of its exposure to competition or its importance to the economy. The coal industry generally seems to be largely protected from serious environmental controls because of its perceived economic significance.

This problem appears to be a feature of existing ‘cap and trade’ systems, as it is relatively easy to apply the system to fixed power generating installations in the developed world, though it is much more difficult to include a number of small polluters, such as the airline industry and private cars in a market system. Here it should be clear that we need to change the relative cost of fuels which generate greenhouse gases compared to those fuels which do not and a tax on petrol or aviation fuel would be much easier to administer and the tax collected could be used by governments to lower the cost of train travel and freight costs to affect a

significant change in the relative prices of various travel activities. The taxes collected could also be used expand and improve the rail network and to subsidise lower income household use of train travel.

Government Failure

In talking about market failure we should recognize that there are cases of government failure in their attempts to regulate markets and allocate scarce community resources. There are a number of reasons for government failure recognized in the literature including:

1. Information problems

The information adequacy and asymmetry problems that beset markets may also affect government attempts to regulate markets as they may have as much difficulty in gaining access to real-time information as other market players, this can be clearly seen in the current attempts being made by governments to mop up the unforeseen consequences of the sub-prime loan fraud. Both the US Federal Reserve and the Bank of England have been forced to enter the market for collateralized debt obligations (CDO) in a late attempt to prop up world financial markets. This has involved the purchase of many poor quality loan packages which have been securitized by various private financial institutions in a desperate attempt to insert liquidity into world financial marks as a first step towards an improvement in confidence and trust. The US Federal Reserve seems to be buying 'junk' loans in its desperation to prevent a financial meltdown in the USA.

The first iteration of the EU ETS failed largely because of information problems, first in predicting the likely level of greenhouse gas emissions from each industry in each country and also because each country appears to have been very late in providing information to the central authorities, so it took some two years for the information problems to manifest themselves. This was too late for the EU administrators to address the problem and the collapse of the market for emissions credits.

2. Ill-defined goals

Governments have a range of goals and some involve social goals and others economic goals. Basically the modern ideology of most governments involves recognition that markets are useful in the allocation of scarce economic resources and that over-regulation will reduce the efficiency of markets. But all governments seem to recognize the need for some regulation to protect those in society that could be hurt by the unconstrained market behaviour of 'insiders'

with special knowledge which can be used in a zero sum game to benefit the 'insider' to the detriment of other uninformed market participants.

The mix of social and economic goals in any attempt to regulate markets drives governments to under-regulate in many cases and this results in many market failures, two very large ones at the moment are Bear Sterns in the USA and the Northern Rock bank in the UK. In Australia we also have the failure of Opes Securities and a range of other companies who have come close to failure or have been forced to a 'fire sale' of assets, including Tricom Securities, Allco Investments and ABC Learning.

Setting up an ETS will require a lot of government effort as the commodity being traded only has value because of a government dictated scarcity. The government will have to set up a registry of firms providing carbon credits and act as guarantor of the validity of the credits sold without being able to audit all such sellers regularly. It will also need to establish and fund a greenhouse credit audit department and an enforcement body with powers to ensure that the market works in an open and effective manner and to minimize potential fraud in the market. It is inevitable that some of the sellers of emissions credits will try to sell credits that are not backed by any reduction in greenhouse gases at some time and it is also certain that some mistakes will be made, such as a plantation of trees which fails.

Thus, the government will have an interest in a market which flourishes and which retains the confidence of all participants for economic reasons and also a social objective of protecting the smaller market participants from any deviant behaviour from 'insiders' or from mistakes and fraud. This mixture of goals is likely to lead to sub-optimal regulatory activity from government, especially as the cost and the difficulty of acquiring suitably qualified people are likely to be further barriers to effective regulation. Any government failure here could be disastrous as the market will deal with an intangible (carbon credits) and it will lead to the creation of derivatives such as futures, options and securitized packages, which will amount to abstractions of the highest order, an ill-defined right to an intangible at some time in the future and in some form which is set down in the agreement or is to be determined in the future.

3. Poor Management resulting from Weak Incentives

The public sector often suffers from ill-defined goals and it does not have a profit motive to drive performance. Good management is a scarce resource and the public sector may not be able to pay enough to recruit and retain appropriately trained managers, though some of the best people are motivated by a sense of 'duty'. Any failure to recruit the best possible staff will create future problems as the government will have to set up the new market for carbon credits and provide a trading mechanism which is transparent and open to all legitimate market players. The public servants who manage this market will need advanced capital

market skills and the ability to second-guess the security of the operations of those market ‘players’ who move too far down the spectrum of creating exotic financial instruments.

4. Regulatory Capture

A feature of government attempts to regulate various markets has been the way the regulated ‘capture’ the regulators, such that the regulators come to represent the interest of those they are to regulate. Many of the boards set up to regulate industries come to feel an affinity for those they are regulating, and this weakens their regulatory capacity over time. In many cases pressure groups will argue for some special subsidy or tax break, often arguing that it is ‘in the public interest’, though it may be at the expense of some other group in the community, and the history of regulation shows that regulators may come to accept some of these claims. The market for carbon credits will depend on the strength of the registration, audit, enforcement and control activities of a group of people who are committed to a transparent, secure and fair market, and the problem of ‘regulatory capture’ could weaken the market over time.

Externalities

For a long time economists and accountants have been aware of the externalities of modern industrial society. This is an important case of market failure whereby business acts within a market so as to affect people outside the market, such an event is unlikely to produce outcomes which are the most efficient use of resources. Since the industrial revolution business has operated in an environment where it did not bear the full cost of production because of its capacity to externalize some of its costs through the pollution of air and water. In the early days of the industrial revolution most of the costs of pollution were borne by the community and over time some of these costs have been returned to business through a range of pollution control regulations which forced business to clean up some of the environmental damage that was a result of production or to bear the cost of installing various pollution control devices.

In recent years the build-up of carbon in the atmosphere has been recognized as a major environmental problem which is likely to lead to global warming, with a range of negative long-term impacts upon the atmosphere of the planet. There seems to be a consensus that urgent action is necessary to curb the build-up of carbon in the atmosphere but no global consensus on how urgent is the action required and the best way to deal with this problem. Many governments seem to have accepted the need to impose a price upon carbon emissions into the atmosphere as the way to generate a market-based adjustment to the relative cost of various sources of the energy. But the developing consensus in favour of a ‘cap and trade’ system of market adjustment may not be appropriate to deal with the present problem of global warming. It could adjust relative prices over time so as to produce a long-term result which is favourable to the environment,

but it may act too slowly and uncertainly to have the desired result. It may also be too difficult for the developing countries which are becoming more important polluters to put a ‘cap and trade’ system in place because they lack the relevant control instruments and accounting structures to measure emissions and to enforce compliance. The European Union’s attempt to put in place a ‘cap and trade’ system should be a warning to all as it started well but almost collapsed because of the lack of transparency in reporting emissions from industries in certain countries and the range of exclusions from the trading base, which has produced huge fluctuations in the carbon price from time to time and a limited overall impact on emissions.

A carbon tax on all fixed energy sources would be much simpler to implement and more certain in impact and if it is desired to have an immediate market-based impact upon the level of emissions it would be better to send a price signal (through taxation) which addressed the cost of the externality imposed upon society by the polluters directly through a tax rather than through a market mechanism which is subject to all the problems of market failure which has produced the carbon pollution problem.

It is imperative that the developed countries show the way forward as they have created the problem through 200 years of uncontrolled pollution of the atmosphere. The level of greenhouse gas emissions from the four worst polluting developed countries is such that their per capita emissions are more than 10 times the per capita emissions from China (which will soon become the largest aggregate greenhouse polluter as its economy continues to grow, but it is important to remember that a developing country such as china has a right to expect that its people will have access to the best technology available to address the problem and that it is doing as much as it can commensurate with its development goals to alleviate greenhouse pollution. China expects to massively increase its nuclear energy sources in the next four years from a current 4 GW of power to around 20 GW of power and China has the world’s largest usage of wind power.

Four Errors in the Literature

1. Clean Coal

   This is misleading and dishonest as the best we can hope for is cleaner coal, not ‘clean coal’, a term developed to convince the disinterested and uninformed and better described as an oxymoron. The cleanest coal will still have the following features:
   a. It will create air and water pollution,
   b. There will still be health hazards for coal miners,
   c. It will involve land degradation and
   d. There remains the risk of CO2 escaping from the underground storage sites and/or contaminating ground water.

2. Renewables Cannot Deliver Base Load Power

Completely untrue, though repeated ‘ad nauseum’ by pressure groups and politicians who are determined to protect coal as the primary source of electric power. The argument is based on the fallacy that the wind does not always blow and the argument that we cannot rely on solar power during the evenings when the sun does not shine.

The uneven wind argument may be correct for a particular location, but in a large country like Australia it is clear that wind farms can be located in more than 100 different sites and that the wind does blow in some of these locations even when there is no wind in particular spots, thus by diversification of the location of wind farms and their association with solar thermal power stations the base load power problem could be solved if the will was there. It is as valid as the idea that we cannot use coal driven power because there is the possibility of a breakdown in supply of coal or because there are occasional breakdowns in the turbines used in power stations. It should also be clear that wind power with gas turbine backup would generate only 10% of the greenhouse gases generated by a traditional coal-fired plant and this combination of power sources could provide totally secure base load power, certainly as secure as that supplied by coal-fired plants.

Australia also has an almost infinite thermal energy resource in the ‘hot rocks’ of South Australia which could be developed over the next few years, though the location would require a significant investment in electrical transmission infrastructure. It is also clear that ‘solar thermal’ power can generate ‘base load’ power if there is a significant investment in the infrastructure to support this. It is cheaper to store hot water in a ‘solar thermal’ plant than it is to store electricity and the relative cost of this power source can be lower than that of a coal-fired power station at the moment if the plant is big enough to generate the relevant economies of scale. Further, it would also be easy to operate a gas turbine ‘back-up’ which can be turned on and off as necessary at relatively low cost to cover all bases.

3. Energy Efficiency is not an Important Part of the Solution

Energy efficiency and conservation could contribute significantly to a cut in the demand for electrical power which would help to reduce greenhouse gases quite significantly in the short run. The Australian Greenhouse Office estimates that ‘business as usual’ (BAU) will produce 702 megatonnes (Mt) of greenhouse gases by 2020 from a base in 2004 of 565 Mt. Thus, they project a 24% growth in emissions over the 16 year period.

An alternative path which reduces the commercial and residential demand for energy which was proposed by Mark Diesendorf[vi] is estimated to save 80 Mt of greenhouse gases, a reduction of 11.4% from the AGO BAU scenario.

4. The Market can Solve the Problem

The argument for an ETS is based upon a philosophical belief that markets can solve the problems of market failure which have caused the global warming problem. This argument is persuasive because markets are, in aggregate and in the medium term, the best way of allocating scarce economic resources yet devised by humans, though they are also subject to manipulation and they have been used as a source of wealth and power by some market participants. We should not forget the market crash of 1987 and the current problems caused by overly deceptive packaging of sub-prime (junk) loans in such a way as to create a huge credit squeeze and great market disorder. In fact when the argument for a market-based solution to the pricing of carbon is analysed closely it can be seen that business is in favour of an ETS because it will generate profits for business and also because the experience so far suggests that it can be avoided by some firms who should be involved. The lack of visibility and transparency of an ETS is likely to encourage an array of special pleaders who will claim some special right to be removed from the system and some unusual financial instruments which aim to divert income into the hands of a few market operators.

A carbon tax will face some of these problems but its transparency will make it harder for firms to mount a private case for special treatment. A tax will make a major contribution to solving the problem if it is hypothecated, so that the revenue is devoted to providing access to ‘green’ technology for all members of the community or for subsidizing the generation of ‘green’ energy for the benefit of all.

The Cost of Carbon and its Pricing

Carbon markets have begun to boom over the last few years, offering firms some options for offsetting their emissions by trading them with ‘cleaner’ firms, but critics of carbon trading contend that it is a distracting ‘con game’ that lets firms dump some carbon in one place while supposedly removing it elsewhere. Information, measurement and pricing are key issues in any market and an efficient market requires well-informed players, an uninformed market will not produce optimal resource allocation decisions and there is the real risk of free-riders taking advantage of market failures to dump carbon at low cost or free of charge.

Determining the effectiveness of the new markets for carbon is sure to get harder as they grow and become international and the large number of players and

different national regulatory regimes will likely produce chaos in the early stages of an uninformed international market. The very concept of carbon trading is an abstraction built upon an abstraction, something like a hedge fund or a financial derivative, it is hard to visualize carbon in the air unlike many other types of environmental pollution such as industrial smoke or other effluent and the trading and pricing of a certificate which represents this mostly invisible substance is hard to understand by most people. Even the more concrete efforts to reduce carbon are hard to measure effectively. Take the attempts to plant trees to develop 'carbon sinks', which are supposed to suck up the carbon in the atmosphere. Planting trees is a good thing to do and the trees look lovely, but it may be easier to count the trees than to measure their effectiveness as a way of absorbing the carbon in the atmosphere. Most of the scientific evidence indicates that new trees are net contributors of carbon into the atmosphere in their first couple of years and only after that do trees act as 'carbon sinks'.

A generally understood measure of the cost of carbon from coal indicates that a price of around $10 per tonne will make coal-fired power stations as costly as gas-fired power stations. This would encourage the building of gas-fired power stations which are much less polluting than those which use black coal. To even the playing field with a range of 'green' energy sources may require a cost of $30 to $40 per tonne of greenhouse gases generated by industry and there have been a range of estimates of the real cost of greenhouse gas pollution ranging from $5 to $125 per tonne[vii]. Further, the UK Government Economic Service in 2002 published a paper, '*Estimating the Social Cost of Carbon Emissions*', which reviewed the available literature on the social cost of carbon and suggested £70 per ton as the appropriate figure for the global damage cost of carbon emissions (within a range of £35 to £140 per ton).

The Design of a Carbon Tax

The two big advantages of a carbon tax over an ETS are that the tax would be more transparent and visible (and thus harder to evade or avoid) and the revenue would flow to an accountable government which would be able to use the extra funds for a socially useful purpose such as providing access to 'green' energy for low income households and to fund green energy sources. The revenue under an ETS would flow to a range of market participants who were motivated solely by their economic interests and who would be encouraged to develop a range of exotic market instruments with uncertain economic consequences over time.

The design of a carbon tax is likely to be much simpler than that of an ETS because the aim is to change the relative price of generating carbon into the atmosphere as a way of reducing the volume of greenhouse gases, whereas an ETS aims to change the price of greenhouse gases indirectly by specifying a fixed quantity of such gases that can be generated in total. As any economist knows it is possible to control the price of a commodity or the volume sold but not

both unless you are a monopolist selling an essential commodity. Business would face greater certainty under a carbon tax because the cost increase would be specified by the tax rate. The tax could start at a low level, equivalent to say $10 per tonne of carbon, which is generally agreed to be too low to have a significant impact on business costs and is unlikely in itself to drive investment decisions and if accompanied by a ten year plan to slowly increase the tax would signal a clear government intention to steadily raise the cost of carbon through tax increases over a specified number of years so as to allow business to adjust to a steady change in price. This could be structured in such a way as to make it easy for business to adjust to a changing price for carbon and where the tax rate change was only one part of the change in total business cost. Also the revenue from a carbon tax will go to the government instead of a range of private sector market players and this revenue can be used to subsidise 'clean' energy alternatives and low income households who are most likely to be affected by an increase in energy prices associated with a steadily increasing price for carbon.

To develop a carbon tax we need to consider two key variables, the tax base and the rate. Clearly the easiest tax base would be stationary energy suppliers which are large and highly visible and which could pass the cost of the tax onto both private and business users of their energy, thus having a broad enough spread to have a direct impact on the quantity of energy demanded and thus the amount of greenhouse gases generated. This would encourage energy conservation strategies and the change in relative price of the various energy sources (with green energy becoming relatively less expensive because it would not bear the carbon tax). The carbon tax base could start with the easy targets where evasion and avoidance was least likely and then move to include a range of other industries, transport being the most likely target after the stationary energy providers because it is a significant greenhouse contributor and because it would be a relatively simple task to place a carbon tax on aviation and motor fuel.

The Inevitability of a Carbon Tax for Developing Countries

Perhaps an ETS could be designed which would not be exploited by industry and by market operators who would be likely to develop derivative securities based upon carbon credits in the developed countries, but experience so far does not provide much evidence in support of this. It is possible to believe that the reason that business interests support the development of an ETS is for largely altruistic reasons of public good, however, this does not exclude the probability that such a system could be exploited by a range of players in their own interests. The experience from Europe also points up the need for highly sophisticated accounting and economic information and tight monitoring and control systems to support an ETS and the failure of the EU to manage their system despite the presence of a set of sophisticated scientific, economic, bureaucratic and political controls over the operation of the system is not encouraging.

The lesson from Europe is of the failure of their initial ETS because of information problems that caused a failure of bureaucratic controls over the system. There was a government failure in not establishing appropriate monitoring and enforcement agencies and a market failure through information asymmetry, which caused the initial system to collapse. Information asymmetry, where 'insiders' have information that others do not have, is a major problem in any market and this is the most common cause of market failures even when the total quantity of information is adequate.

Developing countries do not have the economic and accounting information to make an ETS work nor the resources to set up the appropriate institutions and market manipulation is likely to produce a range of unpredictable and dysfunctional consequences. Many developing countries have difficulty in operating an effective income tax system and raise most government revenue through indirect taxes and it is often relatively easy for citizens to move their wealth and income around so as to minimize their taxes. In such an environment, where the economic and accounting information is not sufficient to operate a comprehensive income tax system, it would be impossible to operate an ETS. A comprehensive solution to the greenhouse problem is not possible without eventually including the large developing countries, especially China and India, neither of which should be forced to bear the cost of the bureaucracy which will be needed for an ETS, however, they will be able to monitor and tax the greenhouse gases emitted from stationary power sources at relatively little cost and the extra revenue that they raise from a carbon tax could be used to compensate lower income people who are likely to be disadvantaged by an energy cost increase.

Conclusion

In economic terms a carbon tax and an ETS are virtually identical, both aim to raise the price of carbon, either directly through a tax impost of indirectly through a cap on the quantity of emissions. Thus, it would seem logical to impose a tax on carbon emissions as this would be simpler and more certain in impact than an ETS. Political fear of introducing a new tax seems to be the only explanation for this as argued by Green, Hayward and Hassett in the American Institute for Public Policy Research Environmental Policy Outlook[viii]:

Most economists believe a carbon tax (a tax on the quantity of CO2 emitted when using energy) would be a superior policy alternative to an emissions trading regime. In fact, the irony is that there is a broad consensus in favour of a carbon tax everywhere except on Capitol Hill, where the 'T word' is anathema. Former vice president Al Gore supports the concept, as does James Connaughton, head of the White House Council on Environmental Quality during the George W. Bush administration. Lester Brown of the Earth Policy Institute supports such an initiative, but so does Paul Anderson, the CEO of Duke Energy. Crossing the two disciplines most relevant to the discussion of climate policy – science and economics – both NASA scientist James Hansen and

Harvard University economist N. Gregory Mankiw give the thumbs up to a carbon tax swap.

Some of the advantages of a carbon tax over an ETS can be summarized as:

1. The impact and incidence of a tax are both more certain as it can be levied on volume of emissions at a publicly announced rate.
2. The impact can be gradual as it can be phased in with scheduled rate adjustments according to an announced timetable.
3. The economic effect will be more certain because the increased cost of emissions will be stable.
4. Revenue will be collected by the government and revenue recycling to low income families and greenhouse gas abatement projects will be feasible.
5. The tax revenue raised could be used to lower other taxes in a way that increased the equity and efficiency of the tax system.
6. A carbon tax would be stable, in contrast to the price fluctuations that would occur in an ETS market, and which has been observed in the EU ETS.
7. The instability of price in an ETS market would add uncertainty and it could adversely impact upon investment decisions and the level of economic activity. Speculators need market fluctuations and uncertainty for their profits.
8. There would be no need for a secondary market or a range of complex derivatives which could distort the flow of revenue and economic activity.
9. Management of a carbon tax would be simpler that an ETS.
10. The integrity of a carbon tax system would be far higher than an ETS because cap and trade systems are inherently more exposed to fraud and evasion with some sellers of permits which do not reduce emissions elsewhere and the buyer will not know about this fraud or mistake in such a time frame as to allow the transaction to be 'unwound'.
11. An ETS is an artificial market created by government for an intangible commodity and it requires the government to create an artificial scarcity for the commodity to have value, whereas a carbon tax does not require any such economic fiction.
12. An ETS will require a range of new institutions such as a registry and audit body, an enforcement body, a monitoring body and a new trading institution, whereas a tax can be administered by existing taxation authorities.

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[i] Garnaut R., (2007) "Will Climate Change Bring an end to the Platinum Age?", Paper presented at the inaugural S.T Lee Lecture on Asia & The Pacific, ANU, 29 Nov 2007.

[ii] Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T Petersen, and M. Prather, (2007) Historical Overview of Climate Change. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on

Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, (referred to as IPCC WG1 AR4).

[iii] Steele, L.P., et al, (1996) Atmospheric methane, carbon dioxide, carbon monoxide, hydrogen and nitrous oxide from Cape Grim air samples analysed by gas chromatography. In Baseline Atmospheric Program Australia. 1994-95. Bureau of Meteorology and CSIRO Division of Atmospheric Research, Melbourne, Australia.

[iv] IPCC WG1 AR4, (2007)

[v] ibid

[vi] Diesendorf M, (2007) "Paths to a Low-Carbon Future", Sustainability Centre, Sept.

[vii] IPCC WG3 AR3, (1996)

[viii] K.P. Green, Hayward S.F. and Hassett K.A. (2007) The American Institute for Public Policy Research Environmental Outlook, Issue 2, Climate Change: Caps v. Taxes.