Environmental Policy Instruments and Policy Principles

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1. Introduction

In recent years the build-up of greenhouse gas emissions 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 (IPCC et al., 2001; The Allen Consulting Group Pty Ltd, 2006). 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 the urgency of the action required and the best way to deal with this problem (IPCC et al., 2007). In this paper we recognize the key roles of science and technology in relation to the problem, as science has identified the problem and the solution lies in developing and sharing alternative technologies (see for example Diesendorf, 2007; The Allen Consulting Group Pty Ltd, 2006). But a key requirement is for behavioural change, as people and businesses will have to change their energy sources from those currently dominated by carbon fuels to alternative 'green energy' sources over time and this can be facilitated by a price signal. If we are to deal with the possible problems of climate change the cost of carbon-based energy must be changed to reflect its full cost, including its environmental damage (Andrew et al., 2010), and there are three main policy instruments available to governments for imposing a price on greenhouse emissions which makes business internalize the cost of their CO_2 emissions currently borne by the community (see e.g. Anthoff & Hahn, 2010; Mokyr, 2008). One popular approach is based on a 'cap-and-trade system', such as the European Union Emissions Trading Scheme (EU ETS) and the Australian Carbon Pricing Scheme [1]. This approach imposes a quantity cap on emissions and expects the resulting scarcity to create a market determined price for emissions (Garnaut & Marnie, 2011). A second approach would levy a charge directly upon polluters through a carbon tax or an emissions fee, this approach would directly impose a price upon emissions and the cost increase could be expected to reduce demand, which will reduce the quantity of emissions indirectly (Baumol & Oates, 1971; Coase, 1960; Pigou, 1952). A third approach would regulate emissions directly through pollution controls, renewable energy requirements or other controls, directly reducing emissions by requiring action by polluting industries to reduce their emissions.

In recent years 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 energy and international law and politics has developed policy principles to guide development of policy instruments. Most developed countries seem to favour a 'cap-and-trade' system (an emissions trading system or ETS) to produce a market adjustment. This approach aims to adjust relative prices for emissions 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. The European Union's attempt to put in place a 'cap-and-trade' system should be a warning to all as it almost collapsed, because of the lack of transparency in reporting emissions from industries in certain countries, extreme price volatility and the range of exclusions from the trading base. This has so far had a limited overall impact on emissions, with a recent example being 2008 emissions which were 145 million tonnes above the cap (Carbon Market Data, 2009).

To which extent a selected number of environmental policy implementations followed theoretically applicable policy principles will be analysed as a starting point for further research into policy instruments and to understand short comings in implementation of policy instruments, while to explore reasons is left to future research. Additionally, this study can guide future policy adjustments or the implementation of environmental policies by drawing lessons from currently existing and past policy instruments' shortcomings.

The remainder of this paper is organised as follows: In section two policy principles relevant to the discussion of policy instruments will be introduced. In section three some literature about the European Emissions trading scheme (EU ETS), in section four about the North American Acid Rain Program as examples of emissions trading and. In section 5 British Columbia's carbon tax will be reviewed. After a comparison of carbon tax and ETS in section 6, some hybrid policy instruments and alternative policy instruments will be considered. Thereafter a summary of the match between policy instrument and their underlying policy principles considered in this study is provided, while the final section presents a conclusion.

2. Policy Principles

The Polluter Pays Principle

Pigouvian theory (see Baumol & Oates, 1971; Pigou, 1952) and double-dividend theory (see Bovenberg, 1999; Clarke, 2011; Goulder, 1995) were widely used to explain environmental taxes and similarly the Coase Theorem (Coase, 1960; Hahnel & Sheeran, 2009; Hashem, 2010) was used to underpin emissions trading. By contrast, the polluter pays principle (PPP) can be applied to regulatory controls such as taxation and an ETS. The origin of the PPP lies in the theory of externalities and "is an economic rule of cost allocation" (de Sadeleer, 2005, p. 21). Pezzey (1988) distinguishes between standard PPP (where companies pay for the cost of pollution control) and expanded PPP (where companies pay additionally for control and damage cost).

The PPP can have different meanings depending on the context (Bugge 1996); in a legal context, Nash (2000) claims PPP to be "a normative doctrine of environmental law" (p. 466), requiring that the one causing the pollution should cover the cost of pollution, rather than the government. The meaning of PPP has changed over time. In the 1970's the OECD and EC saw PPP as a means to prevent distortion of competition, as a way of achieving harmonization which would result in the smooth functioning of a common market and combat distortions caused by subsidy payments (de Sadeleer, 2005). Milne (2004), more recently suggested a spectrum of costs far beyond the initial costs-range under standard/expanded PPP to be covered by polluters.

A question arising under the PPP is who pays? The (abatement) cost borne by the polluter will be partly or fully passed on to the customer, depending on the market structure (monopoly, oligopoly, or competitive) and the elasticity of demand and supply which moves the PPP to the Consumer Pays Principle (CPP) and if a residual pollution cost still exists and is borne by the victims of pollution PPP is consistent with the Victim Pays Principle (VPP) [2] (Kim, 2000; Pearson, 1994).

Both variations of the command-and-control approach (technology or performance specific) are consistent with the PPP as long as governments do not provide financial assistance

(Pearson, 1994). A pollution charge or environmental tax that sets the price at a level which equalizes the marginal social costs of pollution with the marginal social costs of abatement is consistent with the PPP (Pearson, 1994). Subsidies reduce the cost of production and increase the output, which contradicts the PPP; additionally, new entrants are attracted by lucrative government subsidies (Gaines, 1991). An ETS, such as that which applies in Europe, where permits are auctioned or provided free is consistent with the PPP (Pearson, 1994).

The Principle of Prevention
Measures of prevention incorporated in environmental policies are aimed at reducing the risk of harm and to avoid environmental harm in general. Although the objective of the principle seems to be clear, due to the number of diverse legal instruments, the principle of prevention is complex. Most often, the principle of prevention is incorporated in authorizations which specify means of operations, quantities and concentration of pollutants. Additionally, the security measures to be put in place are specified during the time of permission. The prevention can apply to pollution sources and to the points of impact. The former can be imposed through product norms, regulation of production process to prevent harm or assessment of environmental impact prior to their authorization. The latter can be achieved through the establishment of quality standards; with emission standards setting a maximum of harmful substances, or protection of threatened areas.

The PPP, the precautionary principle and the principle of rectifying pollution at source can reinforce the principle of prevention. Policy instruments informed by the PPP introduce a charge on the pollution by the polluter which can reduce or control existing pollution. If damage had already taken place, prevention is no longer relevant, though the PPP may be used to prevent future repetition of damage. The distinction between the principle of prevention and the precautionary principle is about the interpretation of risk. That is, under the principle of prevention, measures relate to cause-and-effect relationships which are known through the cumulative experience. By contrast, caution "comes into play when the probability of a suspected risk cannot be irrefutably demonstrated" (de Sadeleer, 2005, p. 75).

Precautionary Principle
At the Rio Conference in 1992, the definition of the precautionary principle (PP) was agreed upon and manifested in Principle No.15 of the Rio Declaration. The PP is based on the virtue of prudence, where prudence refers to the "ability to discern the most suitable course of action" (Andorno, 2004, pp. 11-12). This definition implies that consequences for the individual and also consequences for the planet and future generations are taken into consideration. The PP might impose higher cost where more cost effective solutions can be discovered in the future if technological change cannot be incorporated into the existing action. The PP is also criticized for requiring more efforts to develop safer and cleaner technologies. Which means PP redirects innovations into a more human and environmentally sound direction (Beder, 2006). The PP can be divided into the weak and strong PP. The former does not specify measures to be taken in response to the PP and under this definition action should be avoided if the benefits of inaction are greater than the cost of action. This viewpoint requires firstly, that costs and benefits can be quantified and measured and secondly, that there is only one way which necessitates environmental sacrifices (Beder, 2006; Pearson, 1994). By contrast, the strong version of the PP requires actions if harm is identified as unacceptable or serious and irreversible, since inaction would not be precautionary, thus violating the PP (O'Riordan and Cameron (1994; for a review see also Richard (2002).

Principle of Sustainable Development
Meaning of the term sustainability varies (see e.g. Kaidonis et al. ,2010) and the most popular form of application in the context of development, 'sustainable development' was found to have 60 different definitions (Pezzey, 1992), with one of them referring to sustainable development as "the ability to develop economically while sustaining the physical integrity of the planet" (Russell, 2008, p.21). For Rehbinder (1994) the principle of sustainable development implies that the environment is the limiting factor for the primary goal of future development in economic, social and cultural spheres.

The sustainable development principle can be found incorporated in the EU-Treaty as a basic objective, as a goal within the NAFTA Side Agreement on Environmental Cooperation (NAFTA, 1993) and in Australia's National Strategy for Ecologically Sustainable Development from 1992 (Commonwealth of Australia, 2011g). Dovers (1996) lists some of the issues governments face with implementation of sustainability in their policies.

Attempts were made to derive further norms/principles from the 'principle of sustainable development', e.g. Sands (2003) suggests: intragenerational equity; sustainable use; intergenerational equity (equitable use) and integration as derived norms. The Commission on Sustainable Development (1995) identifies 19 principles of international law for sustainable development. Rehbinder (1994) highlights that although objectives of PP and the principle of sustainable development in a strict sense might be the same both principles complement each other.

3. The European Union Emissions Trading Scheme (EU ETS)

1 January 2005 marked the start of the EU greenhouse gas emissions trading scheme (EU ETS), which is the largest multi-country, multi-sector greenhouse ETS worldwide (Convery & Redmond, 2007). During the first phase of the EU-ETS the inclusion of companies was limited to certain industries and covered only CO_2-emissions. Across the 25 Member States of the European Union approximately 12,000 installations covering energy activities, production and processing of ferrous metals, the mineral industry and pulp, paper and board activities were included by Phase 1 of the EU ETS (EC, 2011).

Under the EU Directive 2004/156/EC large emitters of carbon dioxide within the EU must monitor and annually report their CO_2 emissions (EC, 2004). In order to achieve a reduction in CO_2 emissions governments had to ensure that the total amount of allowances issued to installations was less than the predicted amount of CO_2 emitted under a business-as-usual (BAU) scenario. Member States' National Allocation Plans set the amount of allowances to be allocated by Member States to their respective installations (Andrew, 2008; Moselle et al., 2010).

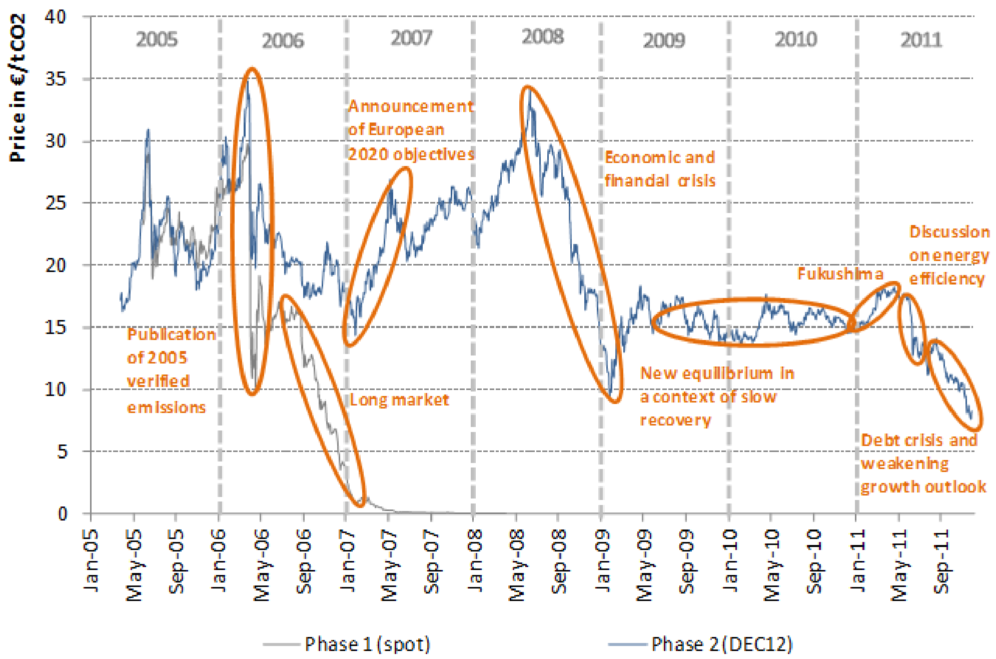
Installations have the obligation to surrender an amount of emissions allowances equivalent to their annual emissions. Installations could get their allowances for free as the Directive 2003/87/EC required government to allocate at least 95 percent of the emissions allowances for free, with a maximum of 5 percent of emissions to be auctioned during the first phase (Ellerman & Buchner, 2007; EU Parliament, 2003). The open market for emission allowances has enabled installations either to buy permits in the case of allowance shortage or to sell accumulated excess allowances to other installations or traders. Additionally, carbon credits from Joint Implementation (JIs), and the Clean Development Mechanisms (CDMs) can be acquired up to a certain limit from Member States' predetermined amount which had to be mentioned in each Member States' National Allocation Plan (Convery & Redmond, 2007; ECOFYS et al., 2006).

During Phase 1 of the EU ETS, European governments allowed their industries as much CO_2-emissions as they could emit which can be seen as a 'major disappointment' (CAN Europe, 2006). Most governments were found to be generous in distributing emission allowances, resulting in the virtual collapse of the carbon market in 2007 and an overall increase in emissions over the initial period. Especially in 2005, emission allowances granted exceeded the actual emissions from installations obliged to participate in the EU ETS by 152 $MtCO_2$ (Committee on Climate Change, 2008). This meant that actual CO_2 emissions were 4 percent below the initial number of emission allowances (Ellerman & Buchner, 2008).

The trading volume of the EU ETS during the year 2005 was about 362 Mt CO_2 at a total value of €7.2 billion. The price for emission allowances increased from about €7 per tonne in February 2005 to almost €30 per tonne in July and ranged between €20 per tonne to €24 per tonne in the second half of the year 2005 (Point Carbon, 2006). From the peak price of €30 per t CO_2, in April 2006 the price fell rapidly and over the next year it fell to €1.2 a tonne due to the excess supply of permits. Price declines continued to €0.10 per tonne by September 2007 which discredited the market and caused calls from many NGOs for more stringent restrictions on CO_2 and tighter allocations of emission credits in the second phase of the scheme (Andrew, 2009b; CAN Europe, 2006; ECOFYS et al., 2006).

Those involved in the second phase of the ETS are confident that the mistakes of the first phase of the system will not be repeated. National Allocation Plans are said to be tighter in the second phase (EC, 2008). In December 2008 future contracts for permits, also known as European Union Allowances (EUA), were traded at around €24, and a secondary market has developed, whereby a financial intermediary accepted the risk of a guaranteed delivery of EUA for a price around €18 (Andrew, 2008). Volatility creates the opportunity for market speculators to gain profits without making any commitment to greenhouse gas reductions (Markandya, 2009). Additionally, gains to market speculators do not provide funds to compensate lower income groups for the additional cost of their contribution to greenhouse gas abatement (Antonia & Creedy, 1996; Callan et al., 2009). High price volatility of an EUA may confront companies with difficulties in business budgeting and planning. As illustrated in Figure 1 below, in July 2008 the price of an EUA was above €30 while falling below €9 later in 2008. Although high volatility is good for speculators it also caused the EU ETS to fail to satisfy the needs of all parties to the system during both phases.

Figure 1: Price Volatility in the EU ETS



Source: Climate Economics Chair from BlueNext and ICE ECX Futures

As can be seen above the first phase of the EU ETS was characterised by extreme price volatility with the price of an EUA falling from above €30 to zero in a short period, largely as a result of EU and Member States' management failures within the system and the over-allocation of permits. The second phase of the system shows evidence of more price stability, yet a fall from above €30 in June 2008 to below €9 in February 2009 is still quite dramatic.

Referring back to the key policy principles, our analysis of the EU-ETS shows that companies subject to the EU-ETS used the market for EUA and increased consumer prices to make windfall profits (Woerdman et al., 2009). Windfall profits gained by companies passing through the price for all emission rights, together with the ones received without charge, suggest that rather than PPP that CPP was achieved. That is, consumers paid while companies achieved extra-gains; a polluters' gain situation. Over-allocation of emission rights makes it questionable to which extent single governments within the EU followed the precautionary, prevention or sustainable development principle in their consideration. The aim of protecting domestic industry was seemingly stronger and no actual $CO\text{-}_2$ reduction was achieved. Carbon Trade Watch and Corporate Europe Observatory (2011) suggest that the EU ETS has not caused any emission reduction and due to overallocation of permits which can be carried forward from the second to the third phase no domestic actions by companies are needed until 2017. This reinforces the concern that the EU-ETS has failed to comply with any policy principle subject to our discussion above (except perhaps the CPP & VPP) and more importantly to reduce CO_2. An answer to which extent the EU-ETS would be improved when implementation issues, such as the overallocation of permits, were prevented is beyond the scope of this paper.

4. The North American Acid Rain Program

The 1990 US Title IV SO_2 Cap is considered to be the most successful ETS, putting a limit on sulphur dioxide emissions (Tiefenberg, 2010). However, Ellerman et al. (2000) claim that the program has not encouraged a movement towards modern renewable energy technologies. Instead, it supported traditional end-of-the-pipe controls (scrubbers) and pollution prevention through application of low sulphur coal (Driesen, 2003). The focus of this scheme was on coal-fired electricity generators and this was relatively easy to manage and monitor. Although the scheme has a narrow focus prices per tonne varied from a low of US$70 in 1996 to US$1,500 in 2005 (Nordhaus, 2005) and varied during the year ending 29 March 2007 alone from US$400 per tonne to US$1,500 per tonne (Smith, 2007). That meant a variation in companies' base operating cost between 7 percent and 26 percent during 1996 (Smith, 2007). She argued that the price variation in the EU ETS over the years 2005-2007 from about US$2 per tonne to US$35 per t CO_2 would cause a coal-fired unit to face variations of base operating costs from about 10 percent and 175 percent (Smith, 2007). These fluctuations impose huge burdens on the management of electricity suppliers and "would be extremely undesirable, particularly for an input (carbon) whose aggregate costs might be as great as petroleum in the coming decades" (Nordhaus, 2005, p. 15).

The failure of the Regional Clean Air Emissions Market (RECLAIM) in Southern California is in contrast to the success of the Title IV program in reducing acid rain. RECLAIM commenced in 1995 setting targets for SO_2 and NO_x emissions and a wide range of trading was encouraged, for example between stationary and mobile sources of emissions (Green et al., 2007). However, the program was substantially abandoned in 2001 since it did not operate as expected. That is, the NO_x emissions fell only by 3 percent between 1994 and 1999 compared to an emissions decline of 13 percent during a five year period before RECLAIM (Green et al., 2007).

These markets showed some mixed success in emissions reduction which might be due to different approaches, design and enforcement of the systems (Ellerman et al., 2000). Further issues in relation to RECLAIM are the: small number of participants with large SO_2 emissions, design problems of the scheme, the complicated nature of operating the US Acid Rain Program (Green, 2007) and after studying the schemes Ellerman et al, (2000, p.321) concluded that "[t]here is a potentially large distance between embracing emissions trading in principle and producing a detailed program that will perform well in practice".

Both US schemes seem to be guided by the pollution prevention, precautionary and sustainable development principles through the reduction of SO_2 or NO_x, however, both schemes achievements, in terms of prevention, were either limited or they supported current practices rather than encouraging or fostering change towards more sustainable, e.g. renewable, energy sources. High fluctuations in prices benefited speculators more than reducing emissions. Literature did not mention who covered the costs but it can be reasonably assumed that the intention was to increase costs for polluters, PPP, which might have passed through some of those costs to consumers so that victims had to cover residual damage.

5. British Columbia's Carbon Tax on Polluters

The Canadian Province of Quebec introduced North America's first carbon tax on 1 October 2007 with a rate of Can$3 per tCO_2 (Duff, 2008), this was followed by British Columbia (B.C.) on July 1, 2008, which introduced a broad consumption-based carbon tax on combustion of fossil fuels and other specified combustibles within the province (Duff & Hsu, 2010). The tax bases, which cover 70% of B.C.'s Carbon Dioxide equivalent (CO_2-e) emissions, are the respective CO_2-e emissions of each fuel used [3]. Fuels exported from British Columbia are excluded or exempted from the carbon tax base as well as CO_2-e emissions resulting from industrial processes from oil, gas, aluminium, or cement production. Also exempted are GHG from disposal of solid waste, the agricultural sector and the combustion of bio-fuels and there is no tax on imported goods and services from other jurisdictions. However, the carbon emissions embedded in exported products and services are not exempt. The rate started off in July 2008 at Can$10 per tCO_2-e, increasing by Can$5 per tCO_2-e on July 1, of each year until 1 July 2012 when it will be Can$30 per t CO_2-e (British Columbia Ministry of Finance, 2008, p.12). The tax revenues gained from this carbon tax are by law required to be returned to taxpayers in the form of tax credits or tax cuts. This includes a tax credit of Can$100 per adult and Can$30 for each child for low income households, which is paid quarterly; reduced personal income taxes (by 5 percent on the first Can$70,000 of income); and lower general corporate income tax (British Columbia Ministry of Finance, 2008).

The revenues resulting from the carbon tax were Can$306 million (M) in 2008/2009, Can$541M in 2009/2010, Can$741M in 2010/2011, Can$939M in 2011/2012 and this is expected to increase to Can$955M in 2014/2015 (Minister of Finance B.C., 2011, Sumner, 2011, Minister of Finance BC, 2012). Apart from increased revenues B.C.'s Provincial Greenhouse Gas Inventory Report mentions a CO_2-e emissions decrease of 4.5 percent between 2007 and 2010, while B.C.'s population increased by 5 percent over the same period (B.C. government, 2012). The PPP together with CPP and VPP seems to apply to a majority (70%) of CO_2-e emission sources. The aimed reduction of CO_2-e emissions is also in line with the precautionary, prevention and sustainable development principle.

6. Comparison between Carbon Tax and ETS

There is little difference between a carbon tax and a price on carbon set in a market transaction in economic terms. "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 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" (Garnaut, 2007, p. 10). The most prominent argument in favour of an ETS is that the economic cost would be lower from an ETS because those firms with a lower marginal cost of abatement would have an incentive to abate and the opportunity to profit from their lower cost of abatement (Hashem, 2010). There is a large body of informed opinion in support of a carbon tax [4] yet the public debate has been dominated by the ETS alternative and it is likely that the current ideological focus on markets has coloured the argument and driven the actions of governments.

It would seem logical to consider imposing a tax on carbon emissions, and it is argued that this alternative approach to pricing emissions should be thoroughly examined. Political fear of introducing a new tax, however, may be the major explanation for government decisions to adopt an ETS (see for example DiPeso, 2005; Green et al., 2007), as the economic argument in favour of an ETS, that it would drive the least cost abatement, also applies to a carbon tax. The same incentives would exist in the case of a carbon tax, firms would reduce their tax if they abated their pollution and all firms would have the same incentive not just those with a low marginal cost of abatement. Some of the advantages of a carbon tax over an ETS are that the tax would be simpler to administer, more economically efficient (Pizer, 1999), more transparent (less open to manipulation) (Markandya, 2009) and more visible (and thus harder to evade or avoid) (Hovi & Holtsmark, 2006).

Much of the revenue under an ETS if allowances are not auctioned 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 and environmental consequences over time. Under a carbon tax 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 (Callan et al., 2009) and to fund green energy sources (Andrew, 2008). The revenue could also be used to improve the economic efficiency of business by cutting a range of inefficient taxes (Stern, 2006). The economic efficiency of a carbon tax would stem from its broad base and its capacity to fund the abolition of a number of inefficient, narrowly-based taxes which exist at the moment (Clarke, 2011; Nordhaus, 2006). To the extent that a carbon tax distorted economic decisions by encouraging investment in low emissions technology it would require a justification from the science as reducing the harm caused by emissions and an economic justification based on the opportunities provided in the new low-emissions economy of the future.

Another feature, in economic efficiency terms, is that a carbon tax could be levied upon the consumers of products which generated carbon pollution in the production process directly through a carbon tax upon consumers. Such a carbon tax upon consumers would operate in the same way as a Goods or Service Tax (GST or VAT) and could be administered without any further complications than a change in the rate (or rates) of tax collected through the GST (Andrew, 2009a; Andrew et al., 2010; Garnaut, 2008). The tax could then be remitted at the border for all exporters in the same way as the GST and this would correct a major inequity in the current the Clean Energy Act 2011 to compensate some exporters only. Under the current Act some exporters will be compensated for the impact of the carbon price by receiving up to 94.5 percent of permits free, while other exporters will receive no compensation and thus be forced to bear the full cost of compliance with the new system (Commonwealth of Australia, 2011b).

Further, in a report to the CEDA (2007) Access Economics “modelling shows, for the same assumed carbon price… [t]he projected decline in welfare, as measured by GNP per t CO_2-e abated within Australia, is smaller for the consumption-based approach than a production-based CPRS approach” (Access Economics Pty Limited, 2009, p. i). The chief executive of CEDA David Byers (CEDA, 2009) said in response to the Access Economics concept modelling that the emissions trading scheme modelled “would involve losses of real GDP per million tonnes of abatement about 50 percent higher than a consumption-based carbon tax”.

A significant advantage of a carbon tax over other instruments is the simplicity of its introduction. In its most basic form it will only require a relatively minor change to the existing tax administration without the need for a major new expansion of administrative machinery or a significant increase in personnel (Andrew et al., 2010; Nordhaus, 2007). Under either an ETS or a carbon tax it will be necessary to monitor emissions from firms and these emissions will provide the tax base if a carbon tax was applied. The existing tax administration could be used to levy and collect the tax from the small number of firms that become liable to pay the tax under any reasonable emissions threshold, such as the current level used for the reporting threshold under the National Greenhouse and Energy Reporting (NGER) legislation of 25 kilotonnes of CO_2-e emissions, this threshold would mean that the tax was collected from less than 500 large firms (Commonwealth of Australia, 2011f) making enforcement activity quite easy because of the small number of firms involved and their size and visibility.

Under a carbon tax the cost increase for business would be specified by the tax rate which was likely to be stable over time or increasing at a rate specified in the legislation. The tax could start at a low level, which may to be too low to have a significant impact on business costs and unlikely to drive investment decisions but which would give business time to develop systems to deal with the tax and to plan abatement strategies so they could avoid paying the tax. If accompanied by a ten year plan to slowly increase the tax this would signal a clear government intention to steadily raise the cost of carbon through tax increases over a specified number of years. In the initial years of the tax it could be structured in such a way as to make it easy for business to adjust to a price for carbon and later tax rate changes would only be one part of the change in total business cost (Andrew, 2009a). This is in contrast to the price determined in a market which experience from Europe and North America shows to be highly volatile, and the volatility of a market price can be contrasted with the stability of a tax levy. Price volatility in a market will make business budgeting and planning much more difficult and it will encourage market speculators to profit from market instability.

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 stationery 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 (Aldy et al., 2010). This would have a broad enough spread to have a direct impact on the quantity of energy demanded and thus the amount of greenhouse gases generated and the stationery energy producers generate a little less than 48 percent of total greenhouse gases in Australia (Beder, 2009). This approach would address a large part of the problem by encouraging energy conservation strategies. It would also drive investment in green energy as 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 (Commonwealth of Australia, 2011e). The carbon tax base could start with the easy targets such as the energy producers or those entities required to report under the NGER Act, where evasion and avoidance was very difficult. Large fixed installations could also be monitored by satellites further making avoidance very difficult (Nader & Heaps, 2008). Heavy industrial users of energy would provide another identifiable and auditable source of emissions, with transport being the most likely target after the stationery energy providers and heavy industrial users. Transport could more easily be dealt with through a carbon tax on aviation and motor fuel, again indicating the flexibility of a carbon tax which could be designed to impose separate levies upon different industries to reflect differences in their structure and the difficulty of enforcement in different cases (Andrew, 2009a).

There are many features that make a carbon tax a superior approach to pricing greenhouse emissions. The design of a carbon tax is likely to be much simpler than that of an ETS if the aim is to change the relative price of generating carbon into the atmosphere as a way of reducing the volume of greenhouse gases and a carbon tax will change the price of carbon-based energy by a specified and predictable amount (Aldy et al., 2008). A carbon tax could be levied on either the consumers of products which contain some carbon or on the carbon footprint of those firms which generate carbon during their production, it could be levied as an excise on fuels if this is a more efficient way to levy and enforce the tax.

A carbon tax could be administered by existing tax institutions and the revenue could be used to remove or reduce, existing narrowly based taxes which distort economic activity, it could be used to compensate low and middle-income households affected by the tax or used to invest in the new technology which is needed to address the current problem. It could be collected and managed by the existing tax authorities and the tax could be remitted at the border for all export industries as is done with the GST. Reimbursement of the tax at the border for all exporters would be fairer than a system which nominates some as emissions intensive trade exposed (EITE) firms which receive massive compensation while other exporters do not receive compensation, as found in the current Australian Carbon Pricing Scheme (Andrew, 2009a; Nordhaus, 2006).

A comprehensive solution to the greenhouse problem is not possible without eventually including the large developing countries, especially China, India and Brazil, none of which should be forced to bear the cost of the bureaucracy which will be needed for an ETS. However, they may be able to monitor and tax the greenhouse gases emitted from stationery power sources and large industrial sites at relatively little cost (Andrew, 2009a). Many developing countries have difficulty in operating an effective income tax system (Andrew & Hughes, 1999; Bird & Zolt, 2005) and raise most government revenue from indirect taxes and charges for services and the levy of a carbon tax on the carbon content of goods and services would give them an additional revenue stream. The extra revenue that they raise from a carbon tax could then be used to compensate lower income people who were likely to be disadvantaged by an energy cost increase (Antonia & Creedy, 1996; Callan et al., 2009) and it could be used to invest in low emissions technology (Andrew, 2008).

7. Hybrid Policy

The hybrid policy most often found in literature is the ‘safety valve’ which could reduce price volatility (Jacoby & Ellerman 2004). The ‘safety valve’ was first suggested by Roberts and Spence (1976) and then further developed by Pizer (2002). Governments using such a policy instrument agree to sell an unlimited number of additional permits at a certain price, which is attractive to companies when the price of permits in the cap-and-trade market exceeds the set price. This will tend to act as a cap on the market price as firms will not normally pay a higher market price than the level set by the government. This is a combination of the two alternatives of environmental tax and ETS (Aldy et al., 2008; Gillingham & Sweeney, 2010; Murray et al., 2009). Pizer (2002) mentions that such a system can make imperceptible welfare improvements and is more predictable than a pure ETS. Keohane (2009) states that “the advantages and disadvantages of such hybrid instruments relative to a cap-and-trade program are essentially the same as those of a tax, differing in degree rather than in kind” (Keohane, 2009, p. 48). In addition to the price ceiling (safety valve) governments could implement a price floor; as happened with Australia’s Carbon Pricing Scheme (2014/2015 onwards). This means that governments would offer to buy permits back at a certain price. Baumol & Oates (1988) however, claim that this would be a subsidy program which is likely to create dynamic inefficiencies. From an economic perspective the combination of safety valve and price floor seems to be prudent. Because the safety valve discourages investment in new emission abatement technologies by putting a limit the on expected permit prices, the price floor, however, ensures returns on those investments and reduces the risk associated with low prices (Burtraw, 2006; Metcalf, 2009). Additionally, a safety valve combined with a price floor limits the extreme fluctuations of the market, but cannot prevent price manipulation as seen in the EU-ETS.

8. Some Other Policy Instruments

There are a range of other policy instruments which could be used to encourage the abatement of GHG, ranging from direct limits on pollution, subsidies to GHG abatement activities, renewable energy targets, ‘green’ projects like tree planting and sequestration of carbon in the soil using biochar (Sohi et al., 2009) [5]. A range of these policy instruments have been applied in different contexts with a certain level of success, especially direct government limits on pollution, but these measures tend to be costly to enforce and costly to business subject to the restrictions. The Australian Government’s Wilkins Committee identified 62 different programs as having been set up by the government and recommended that many of these should be discontinued as they were not compatible with an ETS (Wilkins, 2008). Many of these measures were short-term in impact and only affected a small section of the community and these would not have a long-term impact on prices and behaviour. Without behavioural change it will be impossible to solve the climate change problem (Gupta et al., 2007).

Command and Control Approach

Perhaps the policy instrument with the most potential to reduce emissions in a short time is to mandate a level of renewable energy from all energy supply firms, such as the Renewable Energy (Electricity) Act 2000, as amended (Commonwealth of Australia, 2011d). On the face of it this Act requires energy suppliers to generate 20 percent of their electricity from renewable sources by 2020 in Australia [6], but it has been compromised by concessions to various interest groups, for example coal seam gas (methane) is deemed to be a renewable energy source under the legislation, a patent absurdity. Energy suppliers are encouraged to invest in renewable energy sources and as they supply power from this source they gain Large-scale Generation Certificates (LGCs) [7] which can be sold on the open market or to their customers, such as the energy retailers, who can use LGCs to meet their obligations under the renewable energy target (RET). The energy producers must first invest in renewable energy sources before they obtain LGCs and the financing costs of the new investment will be passed on to consumers as energy prices rise (e.g. Kydes 2007). The longer term impact of the policy will be to increase the volume of energy from renewable sources (see e.g. Carley, 2009; Yin & Powers, 2010; Rabe, 2008) and the extra investment will cause a rise in energy prices which may encourage consumers to cut their energy consumption or themselves invest in decentralized energy from photo-voltaic cells or small wind generators or similar, again having the effect of increasing the supply of renewable energy (see also Gumley & Stoianoff, 2011).

The renewable energy target (RET) can be seen as a command and control (CAC) policy instrument, namely as a performance standard to be met by energy producers. The CAC approach can be divided into two broad groups which are: 1) technology standards and 2) performance standards (Hahn & Stavins, 1991). A technology standard determines the pollution abatement technologies a company has to install, while a performance standard determines the environmental output per unit of a product and is more flexible and cost-effective (Driesen, 2004; Goulder & Parry, 2008). A technology standard specifically tailored to industries can result in more control, thus might lead to higher net emissions abatement benefits compared to an ETS (Hahn & Axtell, 1995; Oates et al., 1989). Technology or performance standards may lag behind the best available technology and they offer little incentive to continue improving pollution abatement (Bohm & Russell, 1985). However, the example of German companies’ responses to standards for SO_2 control shows that technology innovations were achieved (Wätzold, 2004 see also Cole & Grossman, 1999; Driesen, 1998).

One serious problem with governments setting technology standards is that they lack sufficient information to determine cost minimizing carbon emission standards (Metcalf & Weisbach, 2009).

Performance standards in order to achieve cost-effectiveness, have to be set with different performance requirements for companies with different production capabilities (Goulder & Parry, 2008). According to, Goulder and Parry (2008, p. 158) "[d]irect regulatory instruments also fail to engage optimally all of the major pollution reduction channels and, if nontradable, fail to equate the marginal costs of emissions reductions across heterogeneous firms".

The above examples indicate that CAC measures, can result in emission reductions. The costs were born by polluters, though perhaps passed on to customers to some extent with residual damage covered by victims, since no zero-emission point could be achieved.

A Voluntary Approach

The voluntary approach to tackling environmental issues includes agreements and approaches developed by public authorities which companies can voluntarily join. Environmental policy aims to target lower emissions by persuading emitters to contribute to a voluntary scheme. Although the carbon emission reduction targets under such an agreement might be lower than required under CAC regulation, industry compliance is likely to be higher (Kerret & Tal, 2005) and other advantages (lower legal costs, enhanced reputation, improving the relationship to shareholders and the society) stem from membership (see for example Nielson, 2010). The National Greenhouse Response Strategy (NGRS) was adopted by the Council of Australian Governments on December 7, 1992 (Council of Australian Governments, 1992), subsequently due to pressure for stricter measures the Greenhouse Challenge program was introduced in October 1995 by the Keating Labor Government. After Australia signed the Kyoto Protocol in April 1998 the Howard government introduced the National Greenhouse Strategy including a range of programs (Standards for fossil fuel electricity generation (Australian Greenhouse Office, 2010), renewable energy initiatives (Howard, 1997) and the Greenhouse Gas Abatement Scheme) As mentioned by the Australian Senate these measures were difficult to assess (see also Price, 2005). Empirical evidence about the environmental effectiveness of voluntary agreements is variable; some authors (Rietbergen et al., 2002) found significant contribution to energy savings, others (Harrison, 1998; King & Lenox, 2000; Rietbergen & Blok, 2000; Rivera & De Leon, 2004) found little improvement compared to the business-as-usual scenario in which improvements would have taken place even without the voluntary agreement.Under the National Greenhouse Strategy 83 percent of emission reduction was found to be made in the business-as-usual scenario (Senate Environment, 2000). On the other hand the negotiation of voluntary agreements can raise the awareness within the industry towards environmental issues and potential action for mitigation (Kågeström et al., 2000). But voluntary agreements are losing favour since their economic efficiency may be low due to the fact that they rarely equalize marginal abatement cost between all emitters (Braathen, 2005).

As for the National Greenhouse Strategy it is questionable if polluters have incurred additional expenses and made efforts to achieve lower emission levels. Based on that, the PPP and CPP might be rejected however the residual damage is still covered by the victims thus VPP applies in this case. Furthermore, the precautionary, prevention and sustainable development principles would be undermined by companies using the National Greenhouse Strategy to 'green-wash' their current activities in which case it would contradict those principles. After all it will be the victims to pay for residual damage caused by emissions.

Subsidy
Subsidies, either direct or indirect, have implications for markets and might decrease or increase emissions depending on their specific nature. Subsidies aiming at emission reduction can take the form of support in R&D, investment tax credits and price support for renewable energy. The latter was established in the EU, who set prices at which utilities must buy electricity from renewable electricity generation. These so-called ‘feed-in tariffs’ have promoted the development of renewable energy sources (Ackermann et al., 2001; Menanteau et al., 2003). By contrast, subsidies in the fossil fuel sector would increase the consumption of fossil fuels which will lead to higher GHG emission (see e.g. Riedy & Diesendorf, 2003) . Economically, subsidies have the same mechanism as carbon taxes or ETSs. That is, each additional emission implies a cost to the firm in the form of forgone subsidy receipts (Goulder & Parry, 2008). Subsidies are used in the case that a desired outcome (e.g. renewable energy production) would not occur or would occur too slowly under market forces or regulation (Nielson, 2010).

The Productivity Commission (2007) mentions investment support as means to reduce risk and costs of investments in low emission technology R&D, demonstration and deployment. Accelerated depreciation allowances, tax credits and tax offsets that allow small companies to cash out investment equivalents are included in this type of policy. Subsidies can be technology independent and can encourage firms to invest. Yet, this instrument has to be designed in a way that ensures spillovers do not occur and so as to encourage developments which would not be taken in business as usual. However, strategic behaviour by companies to engage in certain activities to gain subsidies would result in a less than efficient allocation of economic resources (Nielson, 2010). Additionally, subsidies provide the wrong output incentives and might lead to excess entry since they lower the average cost of production (opposed to an ETS or a carbon tax) (Baumol & Oates, 1971; Goulder & Parry, 2008). They do not remove market failures which hinder energy efficiency improvements and with each subsidy program administrative costs arise which increase the overall cost of abatement (Productivity Commission, 2008). Under the Clean Energy Act 2011 several subsidies to companies and Australian citizens are mentioned (Commonwealth of Australia, 2011a) [8].

‘Feed in tariffs’ as implemented by the EU increase the cost of electricity for producers relying on fossil fuels and perhaps customers. This kind of subsidy makes polluters pay extra to purchase electricity from renewable sources, thus PPP is applicable, costs might be passed through to consumers, CPP applies and victims of emission have to carry residual damage VPP is applicable. The planned increase in renewable energy can be seen as conforming with the sustainable development principle. EU’s feed in tariff only confirms the precautionary, prevention and sustainable development principle, since they lower the generation of electricity from non-renewable energy sources now and in the future by providing additional incentives for investments into renewable energy sources. The feed in tariff quantifies the amount of electricity from renewable sources. Additionally, without those kind of subsidy an energy shift might not be feasible which can prevent future CO_2 emissions.

By contrast, subsidies (direct or indirect) to the fossil fuel sector which in Australia during 2000-01 made up $6.54 billion (Riedy, 2003) update! are neither compatible with PPP, nor with the precautionary, prevention, nor sustainable development principles. It might be argued though that the subsidies to substitute a ‘dirty’ source of electricity for a more ‘dirty’ one would cause some prevention. However, the economic incentives provided by those subsidies distort the shift towards renewable energies and can be seen as supporting status quo and attracting further investments in the current sources of pollution, thus not in line with abovementioned principles.

Research and Development

In order to achieve the GHG emission reduction plan to cut Australia's emissions by 80 percent compared to 2000 by 2050, substitution among known technological processes is not sufficient; it requires major technological changes and some breakthroughs. Governments can encourage R&D through grants, contracts, tax credits and allowances and public/private partnerships (Gupta et al., 2007). Promotion of R&D in clean technology addresses the market failure beyond the pollution externality such as the inability of companies to fully appropriate the return from their technology development. It was found that the (marginal) private return of innovative activities in general is several times less than the (marginal) social return (Griliches, 1992; Jones & Williams, 1998).

There are different points of view on the role of R&D and its contribution to overall energy innovation. For example Sagar and van der Zwaan (2006), found that there is no correlation between industrialized countries' spending on R&D and the national energy intensity or carbon emissions per unit of energy consumption. While Watanabe (1999) argues that government R&D can trigger breakthroughs and trans-sectoral spillovers. Under the Clean Energy Act 2011 several R&D projects are supported (Commonwealth of Australia, 2011a) [9].

Support for R&D through grants, contracts, tax credits and allowances and public/private partnerships as happening in Australia is not directly in line with the PPP or the prevention and sustainable development principles. Polluters in this case do not have to pay extra, neither do consumers. Prevention and sustainable development might only take place indirectly, that new technologies would help to reduce future emissions. However, the precautionary principle applies, because of R&D's potential to address future not yet quantified risks of potential harm.

Information instruments

Public disclosure requirements, campaigns to raise/improve awareness and education could enhance environmental quality, through impacting on the way consumers make decisions and this could have influence upon business. Consumers and companies, who lack information about the environmental consequences of their actions, might act inefficiently (Gupta et al., 2007; Kennedy et al., 1994). Additional and strong incentives for pollution control are created through public disclosure of companies' environmental performance (Foulon et al., 2002; Powers et al., 2011). The effectiveness of other instruments can be improved by information instruments, although information instruments do not provide direct penalties for environmentally harmful behaviour (Gupta et al., 2007).

The National Greenhouse and Energy Reporting (NGER) Act 2007 can be seen as an example of public disclosure requirements. Companies are obliged to report their greenhouse gas emissions energy consumption and production to the Greenhouse and Energy Data Officer (GEDO), who is publishing an extract from these reports, scope 1 and 2 emissions and the energy consumption of each company annually (e.g. Commonwealth of Australia, 2010). For educational means the Clean Energy Act mentions that $32 million over the period to 2014-2015 will be provided under the Clean Energy Skills Program in order to: support educational institutions and industry in developing expertise and material necessary to promote clean energy skills; help tradespersons and professionals to develop skill necessary to provide to Australian households, communities and businesses, energy efficiency services, clean energy projects and low-pollution products. Also $40 million over the period to 2014-2015 will be provided as grants to industry associations and NGOs in order that they can develop and deliver relevant information about the likely impact of a carbon price on small business and community organisations (Commonwealth of Australia, 2011e).

There is a vast amount of accounting literature examining the role of accounting disclosure in maintaining the status quo, legitimizing and green-washing companies' actions within society (e.g. Deegan, 2002; Deegan & Rankin, 1996; Laufer, 2003; Milne et al., 2009; Moerman & van Der Laan, 2005; Moneva et al., 2006; Puxty, 1986; Tinker, 1984). As for NGER reports, 72 percent of 2009-10 reports contained errors with 17 percent including significant errors (ANAO, 2012). Since, those reports build the basis for the Carbon Pricing Scheme and determine the amount of carbon-permits to be surrendered these reports might be indirectly counterproductive towards PPP by reducing the amount of permits due to be surrendered. There is no link between the costs of reporting and the amount of CO_2-e-pollution (expect of being below or above the threshold which creates the reporting duty), thus PPP is not applicable. From the viewpoint that inaccurate disclosure hampers progress towards credible provision of information, information sources such as the NGER are not compatible with the prevention, precautionary and sustainable development principles. Information sources that provide reliable and decision-useful information are a necessary but not sufficient way to achieve change as they require companies' stakeholders to exert pressure for companies to change their actions.

The Clean Energy Skill program and support to industry associations or NGOs to improve education and information do not raise cost to polluters, customers, or victims, these programs might be justified under the precautionary, prevention and sustainable development principles, but their outcomes remain uncertain.

9. Summary

Previous sections shed light on the capacity of several policy instruments to contribute to the reduction of GHG-emissions with some discussion of underlying policy principles. While some instruments such as the EU-ETS and RECLAIM had the (theoretical) potential to follow underlying principles, implementation issues, political pressure, lobbying and other related issues prevented this achievement. Especially, the EU-ETS, as the largest ETS, has faced issues of getting EU nations' consensus and complying with each countries' legal standards, which has been more difficult than in a single state setting. Our analyses summarized in table 1, can be seen as a starting point for future research to look into the explicit reasons why certain policy instruments do not fit with feasible policy principle, what are the factors (economic, political or social) that hampered the implementation in line with the policy principle. For politicians these findings can support the retrofit of policy instruments in order to comply with environmental policy objectives. Some policy instruments such as 'Support of R&D', 'Clean Energy Skill Program' and 'NGER' are important in contributing either to technology developments, further education with perhaps behavioural change and to build the basic information source (the NGER) to make other policy instruments (e.g. ETS, carbon tax, CAC) possible.

Table 1 – Example of policy instruments and their compliance with policy principles

	PPP	CPP	Precautionary Principle	Prevention Principle	Principle of Sustainable development
EU-ETS	?	x	x	?	?
US Title IV SO_2 Cap	x	x	x	?	?
RECLAIM	x	x	x	?	?
BC Carbon Tax	x	x	x	x	x
safety valve & price floor					
CAC-LRET	x	x	x	x	x
CAC-German SO_2	x	x	x	x	x
National Greenhouse Strategy	?	?	?	?	?
Feed in tariffs	x	x	x	?	?
Fuel subsidies	?	?	-	-	-
Support of R&D	-	-	x	?	?
NGER	-	-	-	-	-
Clean Energy Skill Program	-	-	-	-	-

The comparison between an ETS and a Carbon tax went beyond the discussion between policy instruments to indicate some of the implementation and systemic issues related to the EU-ETS and US Title IV SO_2 Cap compared to a carbon tax such as British Columbia's.

10. Conclusion

In economic terms there is no significant difference between a carbon tax and an ETS. They both aim to raise the cost of emitting greenhouse gases, either directly through a tax imposed or indirectly through a price generated in a market which is established after a cap is placed on the quantity of emissions. A tax on carbon emissions would be simpler to apply and more certain to increase the cost of fossil fuels without the price volatility that we have seen in established carbon markets. Pricing carbon is essential if there is to be an impact on personal and corporate behaviour, and price volatility would make budgeting and pricing decisions much more difficult for business. The political fear of introducing a new tax seems to be a major explanation for the adoption of the market option by many governments, though some have argued that a market-based solution will produce the required change in behaviour at the least cost. The evidence so far indicates that the range of non-market policies put in place are very expensive and this argument seems to be appropriate if the comparison is between market and non-market policies. But a carbon tax and an ETS are both market policies which rely on the price mechanism to drive behavioural change.

A carbon tax has a range of advantages over an ETS. The impact and incidence of a tax would be more certain than that of an ETS as the tax could be levied on the quantity of emissions at a publicly announced rate. The impact could be gradual, as a tax can be introduced with scheduled rate adjustments specified in an announced timetable, which would give industry time to adjust. The tax charge itself would be stable, in contrast to the price fluctuations that have occurred in the largest established ETS market, the EU ETS and the only ETS which was clearly successful in reducing emissions, the US Acid Rain Program.

The economic effect of a tax would be more certain, because the increased cost of emissions would be stable. The instability of prices in an ETS market adds uncertainty to business management which could adversely impact on investment decisions and the level of economic activity in the productive sectors of the economy.

With a tax, there would be no need for a new market of securities related to emissions units created by a government determined scarcity. Trading in the EU ETS is now dominated by option and future trading with up to 95 percent of trading on the London market being in these two derivatives. Derivatives can be used to hedge against risk or used as speculative instruments and it is likely that a range of complex derivatives will be developed in the future which could distort the flow of revenue and economic activity and which would divert income from abatement activities to a small number of market players who were able to exploit the market volatility of an ETS. The management of a carbon tax would be simpler than an ETS and could become the responsibility of existing institutions – unlike an ETS which requires a range of new institutions such as a registry and enforcement body, a monitoring authority, and a new trading entity. The integrity of a tax would be far higher than an ETS, because cap-and-trade systems are inherently more exposed to fraud and evasion. In the EU ETS there appears to be much selling of allowances which do not reduce emissions elsewhere. Emissions units have been stolen from some registries recently and the 'missing trader' fraud has been reported involving the manipulation of VAT and buyers have not known about the fraud or mistake in such a time frame as to allow transactions to be unwound (Frunza, 2011).

An ETS is an artificial market based on a scarcity created by a government for an intangible commodity, it requires a government to create an artificial scarcity for the commodity to have value, whereas a carbon tax does not require any such economic fiction (Nordhaus, 2006, 2007). However, a well constructed market with appropriate access to diverse information sources does provide the possibility of emissions reductions at lower cost through the capacity of high cost firms to trade allowances with lower cost firms. Both systems will have to be driven and managed by government at all times and to describe an ETS as a market system without further explanation does not have regard to the reality of government intervention at all stages of market development and operations. An ETS is driven from above, where government establishes all the market parameters and it will be a market for a very small number of items where it will always be hard for market participants to diversify risk through a rational investment strategy.

Notes

[1] Under the Australian Carbon Pricing Scheme carbon permits will be available to companies at a fixed price from July 2012 to July 2015, increasing by four percent per year. After this fixed price period the permit price will be variable, however a price floor and ceiling applies (Commonwealth of Australia, 2011a).

[2] Chen (1997) mentions that under the VPP the victim of the pollution has to compensate the polluter for not polluting too heavily, or put differently "the affected state [has] to compensate the affecting state (or internal parties creating harmful residuals) for all costs of control and to absorb all residual damages after controls are implemented." (d'Arge & Kneese, 1980, p. 428). Residual damage is difficult to measure as Watkiss (2005a,b) mentions for the social cost of CO_2 emissions many uncertainties from increased

concentration of CO_2 (e.g. redirection of the Gulf Stream, the melting of the West Antarctic ice sheet, floods, droughts, and so on) are difficult to measure and other social contingencies exist (see also Clarkson & Deyes, 2002; Tol, 2005).

[3] Fuels subject to the Carbon Tax are: "fossil fuels used for transportation by individuals and in all industries, including the combustion of natural gas to operate pipelines, as well as road, rail, marine and air transportation. As well, the tax base includes fuel used to create heat for households and industrial processes, such as producing cement and drying coal" (British Columbia Ministry of Finance, 2008).

[4] There is a large body of literature in economics comparing a carbon tax and an ETS and a Wall Street Journal survey found that most economists surveyed favoured some form of carbon tax (Green et al., 2007). A recent report published by the Committee for Economic Development of Australia (CEDA) included a number of papers from economists who favour a carbon tax (CEDA & Marsh 2009) and Professor Gregory Mankiew of Harvard (former chair of the President's Council of Economic Advisers under the Bush Administration) operates a web site entitled the Pigou Club, which includes the names of a very large number of economists and public figures who favour a carbon tax (Mankiew, 2011).

[5] Sequestration using biochar appears to be a cost effective method of CO_2 reduction; e.g. 30 percent of U.S. fossil fuel CO_2 emissions according to Stavins and Richards (2005), might be sequestered at a cost of below US$20 per t CO_2.

[6] The current obligation of Large-scale Generation Certificates (LGC) to be surrendered by electricity producer is determined by the Office of the Renewable Energy Regulator (ORER) through setting a company-specific Renewable Power Percentage (RPP). This requires a company to surrender a certain amount of LGC in order to fulfill their obligation. If a company does not surrender the required number a shortfall charge of currently $65 per LGC applies.

[7] Prior to January 1, 2011, there existed a market for renewable energy certificates which were replaced by LGCs and 'Small-scale Technology Certificates' (STCs), when the renewable energy target (RET) was separated into two parts, the 'Large-scale Renewable Energy Target' (LRET) and the 'Small-scale Renewable Energy Scheme' (SRES). Demand for the latter is created by SRES which places a legal liability on liable entities, mostly electricity retailers, to purchase an amount of small-scale technology certificates each year at a price of $40 or under (Commonwealth of Australia, 2011c).

[8] Approximately $9.2 billion in transitional assistance over the first three years of the Jobs and Competitiveness Program will be received by organizations in the emissions-intensive, trade-exposed (EITE) business environment. $3.2 billion over nine year from 2011-2012 will be provided by the Australian Renewable Energy Agency (ARENA) in order to fund projects through a range of competitive grants programs. $200 million on foregone revenue over the period from 2012-2013 to 2014-2015 will be provided in a form of an increased small business instant asset write-off threshold. Finally, $32 million are provided under the Clean Technology Focus for Supply Chains Program.

[9] $1.2 billion over seven years from 2011-2012 are provided under the Clean Technology Program which is subdivided into following programs: 1) Clean Technology Investment Program ($800 million over seven years from 2011-2012); 2) Clean Technology Food and

Foundries Investment Program ($200 million over six years from 2011-2012) and 3) Clean Technology Innovation Program ($200 million over five years from 2012-2013).

References

Access Economics Pty Limited. (2009), "Preliminary economic modeling of a national consumption-based approach to greenhouse gas emission abatement policy", available at: http://www.ceda.com.au/media/10454/access_economics_carbon_tax_modelling.pdf (accessed 14 September 2011).

Ackermann, T., Andersson, G. and Söder, L. (2001), "Overview of government and market driven programs for the promotion of renewable power generation", *Renewable Energy,* Vol. 22 No. 1-3, pp. 197-204.

Aldy, J. E., Krupnick, A. J., Newell, R. G., Parry, I. W. H. and Pizer, W. A. (2010), "Designing Climate Mitigation Policy", *Journal of Economic Literature,* Vol. 48 No. 4, pp. 903-934.

Aldy, J. E., Ley, E. and Parry, I. W. H. (2008), "A tax-based approach to slowing global climate change", *National Tax Journal,* Vol. 61 No. 3, pp. 493-518.

Andorno, R. (2004), "The Precautionary Principle: A New Legal Standard for a Technological Age ", *Journal of International Biotechnology Law,* Vol. 1 No. 1, pp. 11-19.

Andrew, B. (2008), "Market failure, government failure and externalities in climate change mitigation: The case for a carbon tax", *Public Administration & Development*, Vol. 28, pp. 393-401.

Andrew, B. (2009a), "Advantages of a carbon tax", available at: http://www.cpaaustralia.com.au/cps/rde/xbcr/cpa-site/Climate-change-policy.pdf (accessed 14 September 2011).

Andrew, B. and Hughes, M. (1999), "Some Implications of Different Asia-Pacific Tax Regimes", *AOTCA Technical Reports,* Vol. 5, pp. 5-19.

Andrew, J., Kaidonis, M. A. and Andrew, B. (2010), "Carbon tax: Challenging neoliberal solutions to climate change", *Critical Perspectives on Accounting*, Vol. 21 No. 7, pp. 611-618.

ANAO. (2012), "Administration of the National Greenhouse and Energy Reporting Scheme - Audit Report No.23 2011-12", in. Department of Climate Change and Energy Efficiency, Australian National Audit Office, Barton, Australia.

Anthoff, D. and Hahn, R. (2010), "Government failure and market failure: on the inefficiency of environmental and energy policy", *Oxford Review of Economic Policy,* Vol. 26 No. 2, pp. 197-224.

Antonia, C. and Creedy, J. (1996), "Carbon taxation, prices and inequality in Australia", *Fiscal Studies,* Vol. 17 No. 3, pp. 21-38.

Australian Greenhouse Office. (2010), "Program Guidelines: Generator Efficiency Standards", available at: http://www.environment.gov.au/archive/settlements/ges/index.html (accessed 19 September 2011).

Baumol, W. J. and Oates, W. E. (1971), "The use of standards and prices for protection of the environment", *Swedish Journal of Economics,* Vol. 73 No. 1, pp. 42-54.

Baumol, W. J. and Oates, W. E. (1988), *The theory of environmental policy*, Cambridge University Press, New York.

B.C. Government (2012), "Making Progress on B.C.'s Climate Action Plan", in. B.C. government, Victoria, B.C.

Beder, S. (2009), "Electricity, generation, climate change and privatisation", *Australian Options*, Winter No. 57, pp. 18-20.

Beder, S. (2006), *Environmental principles and policies: an interdisciplinary approach*, UNSW Press, Sydney.

Bird, R. M. and Zolt, E. M. (2005), "The limited role of the personal income tax in developing countries", *Journal of Asian Economics*, Vol. 16 No. 6, pp. 928-946.

Bohm, P. and Russell, C. (1985), "Comparative Analysis of Alternative Policy Instruments", in Kneese, A. V. and Sweeney, J. L. (Eds.), *Handbook of natural resource and energy economics*, North-Holland, New York, NY, pp. 395-460.

Bovenberg, A. L. (1999), "Green Tax Reforms and the Double Dividend: an Updated Reader's Guide", *International Tax and Public Finance*, Vol. 6 No. 3, pp. 421-443.

Braathen, N. A. (2005), "Environmental agreements used in combination with other policy instruments", in Croci, E. (Ed.), *The Handbook of Environmental Voluntary Agreements*, Springer, Dordrecht, NY, pp. 335-364.

British Columbia Ministry of Finance (2008), "*Budget and Fiscal Plan 2008/09-2010/11*", Available: http://www.bcbudget.gov.bc.ca/2008/bfp/2008_Budget_Fiscal_Plan.pdf (accessed 6 October 2011).

Bugge, H. C. (1996), "The principles of polluter pays in economics and law", in Eide, E. and Van der Bergh, R. (Eds.), *Law and economics of the environment*, Juridisk Forlag, Oslo, pp. 53-90.

Burtraw, D. and Palmer, K. (2006), "Dynamic Adjustment to Incentive Based Policy to Improve Efficiency and Performance", in *Resources for the Future*, Washington, D.C., USA.

Callan, T., Lyons, S., Scott, S., Tol, R. S. J. and Verde, S. (2009), "The distributional implications of a carbon tax in Ireland", *Energy Policy*, Vol. 37 No. 2, pp. 407-412.

CAN Europe. (2006), "National Allocation Plans2005-7: Do They Deliver? Key Lessons for Phase II of the EU ETS.", available at: www.climnet.org (accessed 14 September 2011).

Carbon Market Data. (2009), "Key figures on the European emissions trading scheme for the year 2008", available at: http://www.carbonmarketdata.com/cmd/publications/Press%20release%20EU%20ETS%202008%20-%206%20April%202009.pdf (accessed 14 September 2011).

Carbon Trade Watch and Corporate Europe Observatory. (2011), "EU Emissions Trading System: Failing at the Third Attempt", available at: http://www.corporateeurope.org/sites/default/files/sites/default/files/files/article/EU-ETS_briefing_april2011_0.pdf (accessed 22 July 2012).

Carley, S. (2009), "State renewable energy electricity policies: An empirical evaluation of effectiveness", *Energy Policy*, Vol. 37 No. 8, pp. 3071-3081.

CEDA. (2007), "A Taxing Debate: Climate Policy Beyond Copenhagen", available at: http://www.ceda.com.au/research/current-topics/research/2009/11/growth-report/growth61?filterby=Climate%20Policy (accessed 14 September 2011).

CEDA. (2009), "Carbon tax emerges as a genuine alternative - Media release issued: Saturday, 29 August 2009", available at: http://www.ceda.com.au/news-articles/2009/08/31/new_modelling (accessed 23 September 2009).

CEDA and Marsh, I. (2009), *Growth 61: A Taxing Debate - Climate Policy Beyond Copenhagen*, Committee for Economic Development of Australia, Melbourne.

Chen, Z. (1997), "Negotiating an Agreement on Global Warming: A Theoretical Analysis", *Journal of Environmental Economics and Management*, Vol. 32 No. 2, pp. 170-188.

Clarke, H. (2011), "Some Basic Economics of Carbon Taxes", *Australian Economic Review*, Vol. 44 No. 2, pp. 123-136.

Clarkson, R. and Deyes, K. (2002), "Estimating the Social Cost of Carbon Emissions", available at: http://www.hm-treasury.gov.uk/d/scc.pdf (accessed 14 September 2011).

Coase, R. H. (1960), "The Problem of Social Cost", *Journal of Law and Economics*, Vol. 3 October 1960, pp. 1-44.

Cole, D. H. and Grossman, P. Z. (1999), "When is Command-and-Control Efficient? Institutions, Technology, and the Comparative Efficiency of Alternative Regulatory Regimes for Environmental Protection", *Wisconsin law review*, Vol. 1999 No. 4, pp. 887-937.

Commission on Sustainable Development (1995), "Report of the Expert Group Meeting on Identification of Principles of International Law for Sustainable Development, Geneva, Switzerland, 26-28 September 1995", Available: http://www.un.org/documents/ecosoc/cn17/1996/background/ecn171996-bp3.htm [Accessed 6 October 2011].

Committee on Climate Change. (2008), *Building a Low-carbon Economy: The UK's Contribution to Tackling Climate Change; the First Report of the Committee on Climate Change*, The Stationery Office, London.

Commonwealth of Australia. (2010), "National Greenhouse and Energy Reporting", available at: http://www.climatechange.gov.au/government/initiatives/national-greenhouse-energy-reporting.aspx (accessed 21 July 2011).

Commonwealth of Australia. (2011a), "Clean Energy Act 2011", available at: http://www.comlaw.gov.au/Details/C2011A00131/ (accessed 20 July 2012).

Commonwealth of Australia. (2011b), "Clean Energy Amendment Regulation 2012", available at: http://www.comlaw.gov.au/Details/F2012L00417/Explanatory%20Statement/Text (accessed 20 July 2012).

Commonwealth of Australia. (2011c), "Increasing Australia's renewable electricity generation", available at: http://www.orer.gov.au/publications/pubs/ORER_booklet.pdf (accessed 5 September 2011).

Commonwealth of Australia. (2011d), "Renewable Energy Target", available at: http://www.climatechange.gov.au/government/initiatives/renewable-target.aspx (accessed 5 September 2011).

Commonwealth of Australia. (2011e), "Securing a clean energy future – The Australian Government's Climate Change Plan=", available at: http://www.cleanenergyfuture.gov.au/wp-content/uploads/2011/07/Consolidated-Final.pdf (accessed 24 September 2011).

Commonwealth of Australia. (2011f), "Who pays the carbon price", available at: http://www.cleanenergyfuture.gov.au/clean-energy-future/carbon-price/#content02 (accessed 23 September 2011).

Commonwealth of Australia (2011g), "Ecologically Sustainable Development", Available: http://www.environment.gov.au/about/esd/index.html (accessed 6 October 2011].

Commonwealth of Australia. (2012), "GEMS Legislation is introduced into Parliament", available at: http://www.climatechange.gov.au/media/whats-new/gems-legislation-introduced.aspx?utm_source=Department+of+Climate+Change+and+Energy+Efficiency&utm_campaign=c6d8ee366d-Latest-news-week-ending-6-june-2012&utm_medium=email (accessed 25 July 2012).

Convery, F. J. and Redmond, L. (2007), "Market and Price Developments in the European Union Emissions Trading Scheme", *Review of Environmental Economics and Policy*, Vol. 1 No. 1, pp. 88-111.

Council of Australian Governments. (1992), "Council of Australian Governments' Communiqué 7 December 1992", available at: http://www.coag.gov.au/coag_meeting_outcomes/1992-12-07/index.cfm (accessed 19 September 2011).

d'Arge, R. C. and Kneese, A. V. (1980), "State liability for international environmental degradation: an economic perspective", *Natural Resources Journal*, Vol. 20 No. 3, pp. 427-450.

Deegan, C. (2002), "Introduction: The legitimising effect of social and environmental disclosures – a theoretical foundation", *Accounting, Auditing & Accountability Journal*, Vol. 15 No. 3, pp. 282-311.

Deegan, C. and Rankin, M. (1996), "Do Australian companies report environmental news objectively? An analysis of environmental disclosures by firms prosecuted successfully by the Environmental Protection Authority", *Accounting, Auditing & Accountability Journal*, Vol. 9 No. 2, pp. 50-67.

de Sadeleer, N. (2005), *Environmental principles : from political slogans to legal rules*, Oxford University Press, Oxford.

Diesendorf, M. (2007), "Paths to a Low-Carbon Future - Reducing Australia's Greenhouse Gas Emissions by 30 per cent by 2020", available at: http://www.ies.unsw.edu.au/events/DiesendorfWedgesfinal.pdf (accessed 14 September 2011).

DiPeso, J. (2005), "Business makes the case for climate change policy", *Environmental Quality Management*, Vol. 15 No. 2, pp. 99-105.

Dovers, S. R. 1996, "Sustainability: Demands on Policy", *Journal of Public Policy*, Vol. 16, No. 3, pp. 303-318.

Driesen, D. M. (1998), "Is emissions trading an economic incentive program?: Replacing the command and control/economic incentive dichotomy", *Washington and Lee Law Review*, Vol. 55 No. 2, pp. 289-350.

Driesen, D. M. (2003), "Does Emissions Trading Encourage Innovation?", *Environmental Law Reporter*, Vol. 32, January, pp. 10094–10108.

Driesen, D. M. (2004), "Why Pollution Taxes Cannot Replace Command and Control Regulation (But Should Have a Bright Future Nonetheless)", in Milne, J., Deketelaere, K., Kreiser, L. and Ashiabor, H. (Eds.), *Critical issues in environmental taxation: international and comparative perspectives*, Richmond Law & Tax, Richmond, UK, pp. 51-60.

Duff, D. and Hsu, S.-L. (2010), "Carbon Taxation in Theory and in Practice", *Critical Issues in Environmental Taxation*, Vol. VII, pp. 261-276.

Duff, D. G. (2008), "Carbon taxation in British Columbia", *Vermont Journal of Environmental Law*, Vol. 10 No. 1, pp. 87-107.

EC. (2004), "2004/156/EC: Commission Decision of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive

2003/87/EC of the European Parliament and of the Council (Text with EEA relevance) (notified under document number C(2004) 130)", *Official Journal*, Vol. L 059, pp. 0001-0074.

EC. (2008), "National Allocation Plans: Second Phase (2008-2012)", available at: http://ec.europa.eu/clima/documentation/ets/allocation_2008_en.htm (accessed 14 September 2011).

EC. (2011), "Community transaction Log", available at: http://ec.europa.eu/environment/ets/ (accessed 14 September 2011).

ECOFYS, Rathmann, M., Reece, G., Phylipsen, D. and Voogt, M. (2006), "Initial Assessment of National Allocation Plans for Phase II of the EU Emission Trading Scheme", available at: http://www.ecofys.nl/com/publications/documents/Ecofys_Summary_InitialNAP2_Assessment.pdf (accessed 14 September 2011).

Ellerman, A. and Buchner, B. (2008), "Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the 2005–06 Emissions Data", *Environmental and Resource Economics*, Vol. 41 No. 2, pp. 267-287.

Ellerman, A. D. and Buchner, B. K. (2007), "The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results", *Review of Environmental Economics and Policy*, Vol. 1 No. 1, pp. 66-87.

Ellerman, A. D., Joskow, P. L., Schmalensee, R., Montero, J. P. and Bailey, E. M. (2000), *Markets for Clean Air: The U.S. Acid Rain Program*, Cambridge University Press, New York.EU Parliament. (2003), "DIRECTIVE 2003/87/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC", *Official Journal of the European Union*, Vol. L 275/32.

Foulon, J., Lanoie, P. and Laplante, B. t. (2002), "Incentives for Pollution Control: Regulation or Information?", *Journal of Environmental Economics and Management*, Vol. 44 No. 1, pp. 169-187.

Franklin, B. (1840), *The works of Benjamin Franklin, by Jared Sparks*, Childs & Peterson, Philadelphia.

Frunza, M.-C., Guegan, D. and Lassoudiere, A. (2011), "Missing trader fraud on the emissions market", *Journal of financial crime*, Vol. 18 No. 2, pp. 183-194.

Gaines, S. E. (1991), "THE POLLUTER-PAYS PRINCIPLE: FROM ECONOMIC EQUITY TO ENVIRONMENTAL ETHOS", *Texas International Law Journal*, Vol. 26 No. 3, pp. 463-496.

Garnaut, R. (2007), "Will climate change bring an end to the Platinum Age?", in *inaugural S.T Lee Lecture on Asia and the Pacific*, ANU.

Garnaut, R. (2008), *The Garnaut Climate Change Review, Final Report*, Cambridge University Press, Melbourne.

Garnaut, R. and Marnie, S. (2011), "Responding to climate change in our national interest", available at: http://www.garnautreview.org.au/update-2011/events-speeches/sydney-june-1800.pdf (accessed 14 September 2011).

Gillingham, K. and Sweeney, J. (2010), "Market Failure and the Structure of Externalities", in Moselle, B., Padilla, J. and Schmalensee, R. (Eds.), *Harnessing Renewable Energy in Electric Power Systems: Theory, Practice, Policy*, Earthscan LLC, London, UK, Washington DC, USA, pp. 69-91.

Goulder, L. H. (1995), "Environmental taxation and the double dividend: A reader's guide", *International Tax and Public Finance,* Vol. 2 No. 2, pp. 157-183.

Goulder, L. H. and Parry, I. W. H. (2008), "Instrument Choice in Environmental Policy", *Review of Environmental Economics and Policy,* Vol. 2 No. 2, pp. 152-174.

Green, K. P. (2007), "How Should the United States Regulate Greenhouse Gas Emissions? Part II", available at: http//www.aei.org/article/26439 (accessed 14 September 2011).

Green, K. P., Hayward, S. F. and Hassett, K. A. (2007), "Climate Change: Caps vs. Taxes", available at: http://www.aei.org/docLib/20070601_EPOg.pdf (accessed 14 September 2011).

Griliches, Z. (1992), "The Search for R&D Spillovers", *Scandinavian Journal of Economics,* Vol. 94 (Suppl), pp. 29-47.

Gumley, W. and Stoianoff, N. (2011), "Carbon Pricing Options for a Post-Kyoto Response to Climate Change in Australia", *Federal Law Review,* Vol. 39, pp. 132-159.

Gupta, S., Tirpak, D. A., Burger, N., Gupta, J., Höhne, N., Boncheva, A. I., Kanoan, G. M., Kolstad, C., Kruger, J. A., Michaelowa, A., Murase, S., Pershing, J., Saijo, T. and Sari, A. (2007), "Policies, Instruments and Co-operative Arrangements", in Metz, B., Davidson, O. R., Bosch, P. R., Dave, R. and Meyer, L. A. (Eds.), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 745-807.

Hahn, R. W. and Axtell, R. L. (1995), "Reevaluating the Relationship Between Transferable Property Rights and Command-and-Control Regulation", *Journal of Regulatory Economics,* Vol. 8 No. 2, pp. 125-148.

Hahn, R. W. and Stavins, R. N. (1991), "Incentive-based environmental regulation: A new era from an old idea", *Ecology Law Quarterly,* Vol. 18 No. 1, pp. 1-42.

Hahnel, R. and Sheeran, K. A. (2009), "Misinterpreting the Coase Theorem", *Journal of Economic Issues (M.E. Sharpe Inc.),* Vol. 43 No. 1, pp. 215-237.

Harrison, K. (1998), "Talking with the Donkey: Cooperative Approaches to Environmental Protection", *Journal of Industrial Ecology,* Vol. 2 No. 3, pp. 51-72.

Hashem, N. (2010), "THE COASE THEOREM", *Yale Economic Review,* Vol. 6 No. 1, pp. 14-15.

Hovi, J. and Holtsmark, B. (2006), "Cap-and-trade or carbon taxes? The feasibility of enforcement and the effects of non-compliance", *International Environmental Agreements : Politics, Law and Economics,* Vol. 6 No. 2, pp. 137-155.

Howard, J. (1997), *Safeguarding the future: Australia's response to climate change*, AGPS, Canberra.

IPCC, Houghton, J. T., Ding, Y., Griggs, D. J., Noguer, M., Linden, P. J. v. d., Dai, X., Maskell, K. and Johnson, C. A. (2001), *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change,* Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC, Metz, B., Davidson, O. R., Bosch, P. R., Dave, R. and Meyer, L. A. (2007), *Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK and New York, NY, USA.

Jacoby, H. D. and Ellerman, A. D. (2004), "The safety valve and climate policy", *Energy Policy*, Vol. 32 No. 4, pp. 481-491.

Jones, C. I. and Williams, J. C. (1998), "Measuring the Social Return to R & D", *The Quarterly Journal of Economics*, Vol. 113 No. 4, pp. 1119-1135.

Kågeström, J., Astrand, K. and Helby, P. (2000), "Voluntary Agreements-Implementation and Efficiency: Swedish Country Report", available at: http://www.akf.dk/vaie_en/papers/taskc_svensk.pdf/ (accessed 17 July 2011).

Kaidonis, M., Stoianoff, N. P. and Andrew, J. (2010), 'The Shifting Meaning of Sustainability', Aras, G. and Crowther, D. (eds). *A Handbook of Corporate Governance and Social Responsibility*, Gower Publishing Ltd., Farnham, England, pp. 83-90.

Kennedy, P. W., Laplante, B. and Maxwell, J. (1994), "Pollution Policy: the Role for Publicly Provided Information", *Journal of Environmental Economics and Management*, Vol. 26 No. 1, pp. 31-43.

Keohane, N. O. (2009), "Cap and Trade, Rehabilitated: Using Tradable Permits to Control U.S. Greenhouse Gases", *Review of Environmental Economics and Policy*, Vol. 3 No. 1, pp. 42-62.

Kerret, D. and Tal, A. (2005), "Greenwash or Green Gain? Predicting the Success and Evaluating the Effectiveness of Environmental Voluntary Agreements", *Pennsylvania State University Journal of Environmental Law*, Vol. 14 No. 1, pp. 31-84.

Kim, H. J. (2000), "Subsidy, Polluter Pays Principle and Financial Assistance among Countries", *Journal of World Trade*, Vol. 34 No. 6, pp. 115-141.

King, A. A. and Lenox, M. J. (2000), "INDUSTRY SELF-REGULATION WITHOUT SANCTIONS: THE CHEMICAL INDUSTRY'S RESPONSIBLE CARE PROGRAM", *Academy of Management Journal*, Vol. 43 No. 4, pp. 698-716.

Kydes, A. S. (2007), "Impacts of a renewable portfolio generation standard on US energy markets", *Energy Policy*, Vol. 35 No. 2, pp. 809-814.

Laufer, W. S. (2003), "Social Accountability and Corporate Greenwashing", *Journal of Business Ethics*, Vol. 43 No. 3, pp. 253-261.

Mankiw, N. G. (2011), "Member - Pigou Club Homepage – an elite group of economists and pundits that promote the use of pigovian taxes", available at: http://www.pigouclub.com/members (accessed 14 September 2011).

Markandya, A. (2009), "Can Climate Change be Reversed under Capitalism?", *Development & Change*, Vol. 40 No. 6, pp. 1139-1152.

Menanteau, P., Finon, D. and Lamy, M.-L. (2003), "Prices versus quantities: choosing policies for promoting the development of renewable energy", *Energy Policy*, Vol. 31 No. 8, pp. 799-812.

Metcalf, G. E. and Weisbach, D. A. (2009), "Design of a Carbon Tax", available at: http://ssrn.com/abstract=1324854 (accessed 14 September 2011).

Metcalf, G. E. (2009), “Market-Based Policy Options to Control U.S. Greenhouse Gas Emissions”, *Journal of Economic Perspectives*, Vol. 23, No. 2, pp. 5-27.

Milne, J. (2004), "Environmental Taxation: Why Theory Matters", in Milne, J., Deketelaere, K., Kreiser, L. and Ashiabor, H. (Eds.), *Critical issues in environmental taxation: international and comparative perspectives*, Richmond Law & Tax, Richmond, UK, pp. 3-26.

Milne, M. J., Tregidga, H. and Walton, S. (2009), "Words not actions! The ideological role of sustainable development reporting", *Accounting, Auditing and Accountability Journal*, Vol. 22 No. 8, pp. 1211-1257.

Minister of Finance BC. (2012), "British Columbia Budget and Fiscal Plan 2012/13 to 2014/15", in. Minister of Finance, Victoria B.C.

Minister of Finance BC. (2011), "British Columbia Financial and economic review 71st edition April 2010 - March 2011", in. Minister of Finance, Victoria B.C.

Moerman, L. C. and Van Der Laan, S. L. (2005), "Social reporting in the tobacco industry: all smoke and mirrors? ", *Accounting, Auditing & Accountability Journal*, Vol. 18 No. 3, pp. 374-389.

Mokyr, J. (2008), "Entrepreneurship and the Industrial Revolution in Britain", available at: http://faculty.wcas.northwestern.edu/~jmokyr/Baumol-volume.PDF (accessed 23 September 2009).

Moneva, J. M., Archel, P. and Correa, C. (2006), "GRI and the camouflaging of corporate unsustainability", *Accounting Forum*, Vol. 30 No. 2, pp. 121-137.

Moselle, B., Padilla, J. and Schmalensee, R. (2010), *Harnessing Renewable Energy in Electric Power Systems: Theory, Practice, Policy*, Earthscan LLC, London, UK, Washington DC, USA.

Murray, B. C., Newell, R. G. and Pizer, W. A. (2009), "Balancing Cost and Emissions Certainty: An Allowance Reserve for Cap-and-Trade", *Review of Environmental Economics and Policy*, Vol. 3 No. 1, pp. 84-103.

Nader, R. and Heaps, T. (2008), "We Need a Global Carbon Tax - The cap-and-trade approach won't stop global warming", *The Wall Street Journal*, 3 December, p. A17.

NAFTA (1993), “North American Agreement on Environmental Cooperation between the Government of the United States of America the Government of Canada and the Government of the United Mexican States”, Available: http://tcc.export.gov/Trade_Agreements/All_Trade_Agreements/exp_005871.asp (accessed 6 October 2011).

Nash, J. R. (2000), "Too much market? Conflict between tradable pollution allowances and the "polluter pays" principle", *HARVARD ENVIRONMENTAL LAW REVIEW*, Vol. 24 No. 2, pp. 465-535.

Nielson, L. (2010), "Emissions Control: your policy choice ", available at: http://www.aph.gov.au/library/pubs/bn/eco/EmisisonsControl.pdf (accessed 14 September 2011).

Nordhaus, W. D. (2005), "Life after Kyoto: alternative approaches to global warming policies", available at: http://nordhaus.econ.yale.edu/kyoto_long_2005.pdf (accessed 14 September 2011).

Nordhaus, W. D. (2006), "After Kyoto: Alternative Mechanisms to Control Global Warming", *The American Economic Review*, Vol. 96 No. 2, pp. 31-34.

Nordhaus, W. D. (2007), "To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming", *Review of Environmental Economics and Policy*, Vol. 1 No. 1, pp. 26-44.

O'Riordan, T. and Cameron, J. (1994), "The History and Contemporary Significance of the Precautionary Principle", in O'Riordan, T. and Cameron, J. (Eds.), *Interpreting the precautionary principle*. Earthscan Publications, London, pp 12-30.

Oates, W. E., Portney, P. R. and McGartland, A. M. (1989), "The Net Benefits of Incentive-Based Regulation: A Case Study of Environmental Standard Setting", *The American Economic Review*, Vol. 79 No. 5, pp. 1233-1242.

Pearson, C. S. (1994), "Testing the system: GATT + PPP = ? ", *Cornell International Law Journal*, Vol. 27 No. 3, pp. 553-576.

Pezzey, J. (1988), "Market Mechanisms of Pollution Control: 'Polluter Pays', Economic and Practical Aspects", in Turner, R. K. and Economic Social Research Council (Eds.), *Sustainable environmental management: principles and practice*. Belhaven Press, Boulder, Colo, pp. 190-242.

Pezzey, J. (1992), “Sustainable Development Concepts: An Economic Analysis”, Available: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1999/10/21/000178830_98101911160728/Rendered/PDF/multi_page.pdf (accessed 6 October 2011).

Pigou, A. C. (1952), *The economics of welfare*, Macmillan, London, UK.

Pizer, W. A. (1999), "Choosing price or quantity controls for greenhouse gases", available at: http://www.rff.org/rff/Documents/RFF-CCIB-17.pdf (accessed 14 September 2011).

Pizer, W. A. (2002), "Combining price and quantity controls to mitigate global climate change", *Journal of Public Economics*, Vol. 85 No. 3, pp. 409-434.

Point Carbon. (2006), "Carbon 2006", in Hasselknippe, H. and Røine, K. (Eds.), *Carbon Market Insights 2006*, Copenhagen pp. 1-60.

Powers, N., Blackman, A., Lyon, T. and Narain, U. (2011), "Does Disclosure Reduce Pollution? Evidence from India’s Green Rating Project", *Environmental and Resource Economics*, Vol. 50 No. 1, pp. 131-155.

Price, L. (2005), "Voluntary Agreements for Energy Efficiency or GHG Emissions Reduction in Industry: An Assessment of Programs Around the World", in *2005 ACEEE Summer Study on Energy Efficiency in Industry LBNL-58138*, pp. 1-12.

Productivity Commission. (2007), *Public Support for Science and Innovation, Research Report*, Productivity Commission, Canberra.

Productivity Commission. (2008), *What Role for Policies to Supplement an Emissions Trading Scheme?*, Productivity Commission Submission to the Garnaut Climate Change Review, Melbourne.

Puxty, A. G. (1986), "Social Accounting as Immanent Legitimation: A Critique of a Technicist Ideology", *Advances in Public Interest Accounting*, Vol. 1, pp. 95-111.

Rabe, B. G. (2008), "States on Steroids: The Intergovernmental Odyssey of American Climate Policy", *Review of Policy Research*, Vol. 25 No. 2, pp. 105-128.

Rehbinder, E. (1994), “Precaution and Sustainability: Two Sides of the Coin”, Kiss, A. C., Burhenne, W.E., Burhenne-Guilmin, F. and IUCN(eds). *A Law for the Environment: Essays in Honour of Wolfgang E. Burhenne*, International Union for Conservation of Nature and Natural Resources (IUCN), Gland Switzerland and Cambridge UK, pp. 93-102.

Richard, B. S. (2002), "Environmental regulatory decision making under uncertainty", in Stewart, R. B. (Ed.), *An Introduction to the Law and Economics of Environmental Policy: Issues in Institutional Design*. Emerald Group Publishing Limited, pp. 71-126.

Riedy, C. and Diesendorf, M. (2003), "Financial subsidies to the Australian fossil fuel industry", *Energy Policy*, Vol. 31 No. 2, pp. 125-137.

Riedy, C. (2003), "Subsidies that Encourage Fossil Fuel Use in Australia - Working Paper CR2003/01", in. Institute for Sustainable Futures, UTS, Sydney, Australia.

Rietbergen, M. and Blok, K. (2000), "Voluntary agreements- implementation and efficiency: Case studies in the sectors of paper and glass manufacturing", available at: http://www.akf.dk/vaie_en/papers/taskc_netherlands.pdf/ (accessed 17 July 2011).

Rietbergen, M. G., Farla, J. C. M. and Blok, K. (2002), "Do agreements enhance energy efficiency improvement?: Analysing the actual outcome of long-term agreements on industrial energy efficiency improvement in The Netherlands", *Journal of Cleaner Production*, Vol. 10 No. 2, pp. 153-163.

Rivera, J. and De Leon, P. (2004), "Is Greener Whiter? Voluntary Environmental Performance of Western Ski Areas", *Policy Studies Journal*, Vol. 32 No. 3, pp. 417-437.

Roberts, M. J. and Spence, M. (1976), "Effluent charges and licenses under uncertainty", *Journal of Public Economics*, Vol. 5 No. 3-4, pp. 193-208.

Russell, I.S. (2008), “Symposium: Environmental Sustainability: The Sustainability Principle in Sustainable Energy”, *Tulsa Law Review*, Vol.44, Fall, 2008, pp. 121-146.

Sagar, A. D. and van der Zwaan, B. (2006), "Technological innovation in the energy sector: R&D, deployment, and learning-by-doing", *Energy Policy*, Vol. 34 No. 17, pp. 2601-2608.

Sands, P. (2003), *Principles of International Environmental Law*, Cambridge University Press, New York.

Senate Environment, Communications, Information Technology and the Arts Committees,. (2000), "The Heat Is On: Australia's Greenhouse Future", available at: http://www.aph.gov.au/Senate/committee/ecita_ctte/completed_inquiries/1999-02/gobalwarm/report/c08.pdf (accessed 19 September 2011).

Smith, A. E. (2007), "Climate Change: Lessons learned from Existing Cap-and-Trade Programs", available at: http://www.crai.com/uploadedFiles/RELATING_MATERIALS/Publications/files/CRAinsights%202007%20-%20Executive%20Summary%20-%20Climate%20Change,%20Lessons%20Learned%20from%20Existing%20Cap-and-Trade%20Programs.pdf (accessed 14 September 2011).

Sohi, S., Lopez-Capel, E., Krull, E. and Bol, R. (2009), "Biochar, climate change and soil: A review to guide future research", available at: http://www.csiro.au/files/files/poei.pdf (accessed 14 September 2011).

Stavins, R. N. and Richards, K. R. (2005), "The Cost of U.S. Forest-Based Carbon Sequestration.", available at: http://www.pewclimate.org/docUploads/Sequest_Final.pdf (accessed 14 September 2011).

Stern, N. (2006), "Stern Review: The Economics of Climate Change", available at: http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/stern_review_report.htm (accessed 14 September 2011).

Sumner, J., Bird, L. and Dobos, H. (2011), "Carbon taxes: a review of experience and policy design considerations", *Climate Policy*, Vol. 11 No. 2, pp. 922-943.

The Allen Consulting Group Pty Ltd. (2006), "Deep Cuts in Greenhouse Gas Emissions - Economic, Social and Environmental Impacts for Australia", available at: http://www.allenconsult.com.au/resources/GHG2050%20FINAL.pdf (accessed 14 September 2011).

Tiefenberg, T. H. (2010), "The Evolution of Emission Trading", in Siegfried, J. J. (Ed.), *Better living through economics*. Harvard University Press, pp. 42-58.

Tinker, A. (1984), "Theories of the state and the state of accounting: Economic reductionism and political voluntarism in accounting regulation theory", *Journal of Accounting and Public Policy*, Vol. 3 No. 1, pp. 55-74.

Tol, R. S. J. (2005), "The marginal damage costs of carbon dioxide emissions: an assessment of the uncertainties", *Energy Policy*, Vol. 33 No. 16, pp. 2064-2074.

Watanabe, C. (1999), "Systems option for sustainable development--effect and limit of the Ministry of International Trade and Industry's efforts to substitute technology for energy", Research Policy, Vol. 28 No. 7, pp. 719-749.

Watkiss, P. (2005a), "The Social Cost of Carbon ", available at: http://www.oecd.org/dataoecd/19/21/37321411.pdf (accessed 02/07/2012).

Watkiss, P. (2005b), "The Social Cost of Carbon - the Social Costs of Carbon (SCC) Review—Methodological Approaches for Using SCC Estimates in Policy Assessment", in. AEA Technology Environment, Didcot, Oxon, UK.

Wätzold, F. (2004), "SO_2 emissions in Germany, Regulations to fight Waldsterben", in Harrington, W., Morgenstern, R. D. and Sterner, T. (Eds.), *Choosing environmental policy : comparing instruments and outcomes in the United States and Europe*. Resources for the Future, Washington, DC, USA, pp. 23-40.

Wilkins, R. (2008), "Strategic Review of Australian Government Climate Change Programs 31 July 2008", available at: http://www.finance.gov.au/publications/strategic-reviews/docs/Climate-Report.pdf (accessed 24 September 2011).

Woerdman, E., Couwenberg, O. and Nentjes, A. (2009), "Energy prices and emissions trading: windfall profits from grandfathering?", *European Journal of Law and Economics*, Vol. 28 No. 2, pp. 185-202.

Yin, H. and Powers, N. (2010), "Do state renewable portfolio standards promote in-state renewable generation?", *Energy Policy*, Vol. 38 No. 2, pp. 1140-1149.