Global warming:
The case for a coal tax

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1 Introduction

Despite increased awareness of the dangers of global warming, insufficient progress has been made towards agreement on implementation of measures to deal with the problem. Solutions to global warming prescribe decreases in carbon dioxide emissions, yet global projections of emissions indicate further large increases. Current "cap and trade" mechanisms for emission control provide the main focus for discussion, but universal participation in these schemes has not been endorsed. Cap-and-trade mechanisms seemingly portend, at best, a partial and inadequate solution.

It is argued here that a carbon tax, in particular one applied specifically to coal consumption initially, can provide a better, more practical solution, and one that has a greater possibility of success. Australia, as the world's leading coal exporter, is uniquely placed to advocate, and to play a key role in implementing this global solution.

2 The nature of the problem

In Rio de Janeiro in 1992, 189 countries, including the US, China, India, and all the European nations, signed the UN Framework Convention on Climate Change. At that time, they all agreed to stabilise greenhouse gases "at a low enough level to prevent dangerous anthropogenic interference with the climate system." In 1997 the Kyoto Protocol was opened for signature. In this, countries generally undertook to reduce their CO_2 emissions in 2008-12 by various amounts, typically 5 per cent, compared to 1990 levels.

Despite these undertakings, as time has progressed, and as the problem has become more apparent and more acute, commitment to achieving these goals, in some quarters has been equivocal, and in certain cases, has diminished.

The 2006 Stern Review, "*The Economics of Climate Change*", defined the magnitude of the task:

> *Stabilisation at or below 550 ppm CO_2e would require global emissions to peak in the next 20 years then fall at the rate of at least 1-3 per cent per year. By 2050 global emissions would need to be around 25 per cent below current levels. Given the global economy in 2050 may be up to four times larger than today, emissions per unit of GDP may need to be a quarter of current levels by 2050.*

The Institute for Public Policy Research suggests that even this target is likely to be insufficient, and that CO_2 concentrations should be limited to that which would produce a global temperature rise of no more than 2°C. The Stern target of 450-550 ppm CO_2e entails a "medium to high" risk of exceeding this temperature increase. Beyond this threshold, "the extent and magnitude of impacts are likely to increase in a way that may widely be considered as being dangerous, and in some cases irreversible." It continues: "We do not have decades in which to bend the global CO_2 curve: we have less than ten years" (IPPR "Designing emissions pathways to reduce the risk of dangerous climate change")

Despite these dire warnings, current projections for energy use and fossil fuel consumption indicate that Kyoto targets will not be met and that CO_2 emissions will not decrease but increase dramatically. The US Energy Information Administration (IEA), in their International Energy outlook 2007, project that from 2004 to 2030, use of liquid fuels will increase by

42 per cent, natural gas by 63 per cent and coal by 74 per cent. Clearly there is a massive disconnection between GHG abatement requirements, and what projections based on current global practices and intentions appear to indicate.

The magnitude of the problem can be indicated as follows. Currently 24 per cent of GHG emissions come from power generation, of which 41 per cent comes from coal*. Even if coal fired generation were completely phased out by 2050, this alone would still be insufficient to meet the stated abatement requirements.* Stern states the problem in similar terms:

> *The power sector around the world will have to be at least 60%, and perhaps as much as 75%, decarbonised by 2050 to stabilise at or below 550 ppm CO_2e*

The projections from the EIA that we are faced with however, indicate a share of coal in global emissions rising from 39 per cent in 2004 to 43 per cent in 2030, principally due to a projected 146 per cent increase in coal use in China's electricity sector. China and India account for 72 per cent of the projected increase in global coal consumption to 2030. It has been suggested that the increase in China's emissions represent about five times what Kyoto implementation will save.

These projections appear quite incompatible with a solution to global warming and portend climate change resulting in a possibly catastrophic increase in sea levels. It is incumbent upon the global community to work together with China and India to find alternative energy solutions.

Most efforts have been invested in proposals for cap-and-trade solutions on the grounds that a global carbon tax is ether undesirable or beyond the possibility of global agreement. Following the 2007 G8 summit however, in response to suggestions that the larger developing nations must be part of the solution to climate change, representatives of both China and India expressed reluctance to commit to any quantified emissions reduction targets or mandatory restrictions.

It seems quite understandable that the regulatory environment in China in particular would not be readily adaptable to the intricacies of the cap-and-trade proposals. It is argued here that a carbon tax, or at least a tax on coal combustion, applied globally, is a more desirable and feasible solution. How is it that so much emphasis has been placed on cap-and-trade proposals, given their somewhat limited scope and therefore plausibility of success?

3 Cap-and-trade versus a carbon tax

The implementation problems of cap-and-trade schemes are well known. These include design questions such as issuing or auctioning the "permits to pollute", the scope of coverage, duration, as well as the more abstract notions of offsets, additionality and special treatments. They are schemes that may inevitably be ripe for exploitation by interest groups, and prone to blame-shifting and obfuscation. In addition, such schemes provide a price signal that is unclear and undesirably unstable and uncertain. Trading schemes however, would at least appear to be preferable to mandatory requirements that provide no price signal at all.

By contrast a carbon tax is administratively simple, provides a clear and universal price signal, is flexible, provides the required incentives, gives clear direction to long term investment planning and provides revenue to offset distributional consequences. A carbon tax targets both demand as supply – demand initially, then supply substitution. It does not "pick winners". Such taxes have been the standard solution to market failure caused by negative externalities since first proposed by Arthur Pigou nearly a century ago. As Stern

says, global warning is that biggest market failure in the history of humanity. How is it then, that a carbon tax has seemingly been discounted as a solution?

Perhaps part of the reason has been the ability to sell cap-and-trade as a “market solution”. This is an argument that perhaps attractive to politicians as it allows them to evade direct responsibility for higher energy prices. A carbon tax, by contrast, can be perceived or portrayed as symptomatic of “big government”, which has negative connotations.

In reality however, cap-and-trade systems are not purely market solutions. While the quantities traded and permit prices may be market determined, the quantity allocations and the overall cap is government determined. Indeed, it could be argued that the allocation of permits and the determination of output quantities as envisaged by the cap-and-trade model have more in common with central planning than market economics. Its likelihood of ultimate success may also be similar.

It has been widely assumed that international agreement on a carbon tax is implausible and that cap-and-trade is better than nothing. However relying heavily on a scheme with limited prospects of success may be worse than nothing. It allows politicians and industry to give the appearance of doing something credible, while in reality achieving rather little.

Rather than a carbon tax itself, the key stumbling block appears to the concept of a global tax. Certainly such a tax would need to be global, as unilateral implementations would be self-defeating. The key to selling such a policy is to focus on who may gain, and who would have the incentive to support such a tax.

While it may seem counter intuitive, the first step to a global carbon tax can be an export tax on energy goods. Given demands are inelastic, exporters will collectively gain from the uniform implementation of such a tax. Therefore there is incentive for them to do so. Exporters, or governments on their behalf, acting collectively, can use their market power to raise prices, in the form of an export tax on carbon.

The idea of an export cartel is of course not new. OPEC was able to prove, at least for a time, that such a cartel could be very effective. The difference would be that implementing price increases in the form of a carbon tax, via a cartel arrangement, as a solution to global warming, is something that could be promoted as positive not negative, planet-saving not self-serving. Ideally, such a tax would apply to all fossil fuels, including oil and gas as well as coal. However, a tax on coal alone, at least as first step, would still be effective.

- Coal is the most carbon intensive fuel and it is also the cheapest and most plentiful. Therefore it would be the most beneficial target for a GHG abatement tax.

- International resource prices are frequently taken as a benchmark for domestic prices. Therefore an export tax would have some flow on into domestic coal markets that are not traded.

- The increase in coal prices would cause a flow on into other fossil fuel prices. Such fuels already have a scarcity component in their price, which is likely to increase, and will increase further with the substitution effects caused by a coal tax.

A uniform export tax on coal of course differs from a global carbon tax. A coal tax would be less effective than a general carbon tax. However, the implementation of a coal export tax would be far more feasible because the agreement of only a small number of exporting countries would be required and each would have an incentive to participate.

Coal importing countries may naturally feel a degree of resentment at the imposition of such a tax. There is certainly a degree of inequity in that non-importers would not bear a similar

cost burden. Ways could be found however to mitigate these concerns. A proportion of tax revenue could be used to compensate importers with GHG abatement assistance, or tax payments could be used as a credit in other abatement schemes.

4 Australia's role as a coal exporter

If an international coal tax is to be implemented, as a precursor to a global carbon tax, then it is perhaps incumbent upon Australia to propose it. This is due to Australia's dominant role as a coal exporter. Certainly no such scheme could eventuate without Australia's participation. Table 1 shows the value of exports for the top ten exporting countries. The penultimate column shows the percent of world exports 2001-2005, indicating that Australia provided 37 per cent or world exports over the period. The final column shows the cumulative percentage, indicating that 95 per cent of global exports were provided by only these ten countries. Therefore a viable coal tax regime could be implemented with the agreement of just these ten countries or less.

Table 1 Coal, exports by country (US$ billion)

	2001	2002	2003	2004	2005	%	+%
Australia	6.450	6.997	7.077	9.827	16.643	37	37
Indonesia	1.617	1.762	1.980	2.748	4.354	10	47
China	2.666	2.532	2.750	3.811	4.272	9	56
U.S.	1.828	1.601	1.548	2.596	3.345	8	84
Russia	1.200	1.150	1.722	2.754	3.756	8	72
South Africa	1.440	1.839	1.803	2.431	3.269	7	79
Canada	1.178	1.067	1.104	1.316	2.652	6	85
Colombia	1.159	0.972	1.390	1.765	2.440	5	90
Poland	0.916	0.815	0.745	1.380	1.511	4	94
Netherlands	0.576	0.316	0.282	0.583	0.658	1	95

Source: International Trade Centre – UNCTAD/WTO.

Globally, consumption of coal is mostly provided by domestic production, with internationally traded coal providing only 15 per cent of the total world consumption in 2004. According to the EIA this proportion is expected to decrease to 13 per cent by 2030 due to greatly increased production of coal in China for domestic consumption. This projection may be problematic, for reasons of reserve depletion, as will be discussed below. However it is clear that at least initially, the burden of the tax would fall disproportionately on coal importing countries.

Coal imports by major importing country are shown in Table 2. Japan is the major importer of coal with 24 per cent of global imports. Together with Korea, Taiwan and the United Kingdom, the top four importers receive almost half of globally traded coal.

The attitude of China will be key to the achievement of agreement on the implementation of a coal tax. China has been a net exporter of coal, and as such would thus be a beneficiary of the tax, although this may change. The fact that the burden of the tax would fall disproportionately on countries that happen to be neighbours of China, may not represent a major diplomatic obstacle in obtaining China's support for the proposal.

Table 2	Coal, imports by country (US$ billion)						
	2001	**2002**	**2003**	**2004**	**2005**	**%**	**+%**
Japan	6.198	6.283	6.430	10.117	13.703	24	24
Korea	2.318	2.442	2.490	4.218	5.346	9	33
Taiwan	1.626	1.721	1.845	3.018	3.831	6	39
U.K.	1.698	1.278	1.509	2.438	3.414	6	45
India	0.961	1.027	1.076	2.017	3.380	6	51
Germany	1.255	1.114	1.126	2.209	2.453	4	55
Italy	0.992	0.935	1.019	1.769	2.152	4	59
Netherlands	1.217	0.777	0.902	1.371	1.662	3	62
Spain	0.782	0.947	0.858	1.462	1.765	3	65
France	0.675	0.786	0.844	1.356	1.720	3	68
U.S.	0.772	0.677	0.913	1.168	1.642	3	71
Brazil	0.677	0.727	0.747	1.096	1.563	3	74
Turkey	0.297	0.678	0.926	1.217	1.573	2	76
Canada	0.664	0.696	0.641	0.757	1.044	2	78
Belgium	0.553	0.573	0.583	1.050	1.153	2	80
Israel	0.447	0.464	0.469	0.683	0.833	2	82
China	0.087	0.328	0.363	0.891	1.383	2	84
Ukraine	0.287	0.207	0.449	0.900	0.713	1	85

Source: International Trade Centre – UNCTAD/WTO.

5 International coal tax – macro effects

The idea of a coal tax on exports can be further examined by considering the macroeconomic effects of such a tax across countries throughout the projection period. An attempt at measuring effects of the introduction of a uniform tax on traded coal has been simulated here by use of a global macroeconomic model. The particular model used here for this purpose, is still in development by NIEIR, but can provide useful indications of the likely impacts of such a policy. The model, denoted the UnLink Model, is based of the data set used by the United Nations Project LINK global forecasting model, with which NIEIR has long been associated.

In the field of economic model building it may be considered that there are two classes or types of model into which most operational models could be said to fall: general equilibrium comparative static models, and time series econometric models. The former tend to rely heavily on economic theory, with parameters imposed externally, while the latter are less theoretic and rely heavily on empirical estimation of parameters. The UnLink Model however, is a hybrid between these two classes. In this model, most of the parameters are elasticities, and are imposed externally. It has the structure however of a multi-country national accounts based time series model. The model is contingent upon the plausibility of the elasticities and is validated principally by behavioural response of the model to various experimental stimuli or exogenous shocks. Details of the model are provided in “The UnLink Model – Structural Outline”, NIEIR Working paper.

The model has the ability to track, through a given time period, changes that may occur as result of a particular price stimulus or exogenous event. It is particularly suited to investigate impacts on global trade flows, since almost all countries are included, so that there is a balance in the model between total world exports and total world imports. The results it

produces largely reflect the relative magnitudes of different variables that pertain at different time periods. Currently the operational range for experimentation with the model is restricted to the period 2003 to 2008. The effect of a policy simulation conducted over this time period however can still be taken as indicative of the results that may subsequently be obtained, over later time period.

Table 3 Effect of coal price increase – demand price elasticity = 0.1

	2003	2004	2005	2006	2007	2008
Coal price ($US/tonne)						
World price (percentage change)	4.57	7.39	11.64	16.73	21.98	27.29
Coal exports ($US billion – differences)						
Australia	0.284	0.694	1.653	2.361	3.398	4.628
Canada	0.043	0.099	0.270	0.373	0.504	0.719
China	0.110	0.274	0.425	0.643	0.994	1.497
Colombia	0.057	0.128	0.245	0.358	0.511	0.686
Indonesia	0.081	0.200	0.436	0.612	0.899	1.265
Poland	0.028	0.092	0.156	0.235	0.358	0.540
South Africa	0.072	0.168	0.329	0.440	0.722	0.993
United States	0.065	0.204	0.344	0.546	0.858	1.260
Russian Federation	0.058	0.173	0.396	0.614	0.886	1.239
World	**0.845**	**2.165**	**4.495**	**6.544**	**9.657**	**13.574**
Coal imports ($US billion – differences)						
Belgium	0.025	0.058	0.104	0.141	0.185	0.234
Brazil	0.033	0.092	0.168	0.259	0.370	0.513
Canada	0.031	0.079	0.122	0.162	0.200	0.242
China	0.015	0.045	0.106	0.203	0.346	0.566
Finland	0.010	0.014	0.040	0.062	0.090	0.125
France	0.034	0.100	0.190	0.294	0.431	0.608
Germany	0.050	0.137	0.269	0.402	0.567	0.771
India	0.046	0.137	0.288	0.525	0.879	1.430
Israel	0.021	0.058	0.102	0.146	0.204	0.264
Italy	0.041	0.117	0.218	0.338	0.490	0.685
Japan	0.283	0.790	1.422	2.140	2.994	4.034
Korea, R.	0.113	0.302	0.539	0.910	1.455	2.253
Mexico	0.011	0.033	0.056	0.092	0.134	0.188
Netherlands	0.034	0.097	0.176	0.262	0.372	0.509
Spain	0.040	0.108	0.194	0.283	0.391	0.521
Taiwan	0.066	0.202	0.367	0.642	1.141	1.892
Thailand	0.006	0.052	0.080	0.103	0.131	0.167
Turkey	0.030	0.094	0.170	0.254	0.356	0.491
United Kingdom	0.057	0.175	0.343	0.565	0.864	1.262
Ukraine	0.009	0.038	0.093	0.153	0.240	0.371
United States	0.030	0.095	0.169	0.255	0.355	0.477
World	**1.107**	**3.180**	**5.885**	**9.222**	**13.722**	**19.786**
GDP, real, local currency (percentage change)						
Australia	0.13	0.27	0.63	0.85	1.22	1.65
Colombia	0.07	0.14	0.25	0.33	0.47	0.60
India	-0.01	-0.03	-0.05	-0.08	-0.13	-0.19
Indonesia	0.04	0.10	0.22	0.29	0.43	0.58
Korea, R.	-0.04	-0.06	-0.09	-0.15	-0.22	-0.33
South Africa	0.06	0.09	0.15	0.17	0.25	0.23
Poland	0.02	0.04	0.06	0.08	0.12	0.16
Taiwan	-0.03	-0.06	-0.09	-0.16	-0.26	-0.40
Ukraine	-0.01	0.00	-0.06	-0.06	-0.12	-0.12

Source: UnLink Model – National Institute of Economic and Industry Research.

To simulate the impacts of the introduction of an international coal price, the price of coal in the model has been increased by 5 per cent per year, cumulatively, for each year 2003-2008. The results are then compared with a base run in which the price was not increased. The critical parameter in the model that will determine the results obtained from this experiment is the value assigned to the price elasticity of demand for coal in the various country import equations.

Experiments based on two different values for coal demand elasticity, assumed to be uniform across countries, are reported. The first is where an elasticity of 0.1 is assumed, which means, for example, that a 10 per cent increase in price would result in only a 1 per cent decrease in the volume of coal imports, and therefore an approximate 9 per cent increase in the value of exports. This represents an inelastic demand for coal, a situation that could be expected to apply in the short term. The second simulation experiment is based on an elasticity of 0.5, which represents what would be expected in the longer term.

The results of the first experiment are reported in Table 3. As a result of a cumulative 5 per cent increase in the price of coal (data based on the Asia spot price), the value of Australian coal exports increase by US$4.5 billion, Indonesian and Chinese export values increase by over $1 billion and world exports by over $13 billion. For imports, the price increase results in a $4 billion increase in Japanese coal imports, $2.2 billion for Korea and $1.9 billion for Taiwan. In terms of real GDP however the negative impacts on the countries bearing the increased costs are relatively minor, with Taiwan suffering the largest decrease of 0.4 per cent decrease. For Australia the impact is a 1.6 per cent increase after 5 years.

In a second experiment, the results obtained under the assumption of a 0.5 price elasticity of demand for coal are presented in Table 4. All the effects are somewhat moderated compared with the previous Table because the price increase results in a greater reduction in import volumes and a correspondingly reduced increase in the value of coal imports. The major effects after five years are a US$2 billion increase Australian exports with a similar increase in Japanese imports. The major impact on GDP is a 0.8 per cent increase of GDP in Australia.

It should be noted that in these results, no specific allowance has been made for energy substitution in relation to total energy requirements. The results are obtained purely as a result of an increase in the price of coal taking into account only the macroeconomic effects of computed changes in trade flows. The tax is assumed to be equivalent to a commodity price increase, where the benefit accrues to the exporting country via the national accounts. If assumptions were to be made regarding distribution of tax revenues, to importing or other countries, different results would be obtained.

Naturally the results also depend on assumptions made regarding the input elasticities, in particular those for coal import demands. In inferring such elasticities from historical data, it is difficult to distinguish between income and price effects on demand. Over the period simulated, the price of coal and the volume of exports both doubled, so it could be considered that the results provided by the inelastic assumption are entirely plausible, at least subject to the other limitations of the modelling.

Table 4 Effect of coal price increase – demand price elasticity = 0.5						
	2003	**2004**	**2005**	**2006**	**2007**	**2008**
Coal price ($US/tonne)						
World price (percentage change)	4.57	7.39	11.64	16.73	21.98	27.29
Coal exports ($US billion – differences)						
Australia	0.144	0.322	0.780	1.157	1.706	2.344
Canada	0.022	0.048	0.132	0.190	0.263	0.379
China	0.053	0.122	0.191	0.299	0.472	0.714
Colombia	0.029	0.060	0.118	0.177	0.259	0.350
Indonesia	0.040	0.093	0.205	0.297	0.446	0.632
Poland	0.014	0.042	0.072	0.113	0.178	0.272
South Africa	0.036	0.077	0.154	0.214	0.360	0.501
United States	0.034	0.098	0.168	0.278	0.449	0.667
Russian Federation	0.029	0.078	0.186	0.301	0.447	0.634
World	**0.425**	**1.001**	**2.117**	**3.199**	**4.839**	**6.865**
Coal imports ($US billion – differences)						
Belgium	0.010	0.019	0.037	0.053	0.073	0.096
Brazil	0.018	0.047	0.090	0.140	0.204	0.282
Canada	0.016	0.037	0.059	0.082	0.105	0.129
China	0.008	0.023	0.055	0.110	0.194	0.321
Finland	0.005	-0.004	0.007	0.018	0.032	0.049
France	0.018	0.048	0.093	0.150	0.228	0.329
Germany	0.026	0.066	0.131	0.203	0.297	0.410
India	0.024	0.066	0.142	0.270	0.464	0.763
Israel	0.012	0.029	0.052	0.079	0.115	0.152
Italy	0.021	0.057	0.108	0.173	0.261	0.372
Japan	0.157	0.401	0.731	1.148	1.659	2.268
Korea, R.	0.045	0.105	0.188	0.334	0.556	0.876
Mexico	0.006	0.017	0.029	0.050	0.075	0.108
Netherlands	0.017	0.044	0.082	0.125	0.184	0.257
Spain	0.021	0.052	0.095	0.144	0.207	0.283
Taiwan	0.024	0.068	0.126	0.234	0.433	0.740
Thailand	0.003	0.041	0.059	0.074	0.092	0.114
Turkey	0.016	0.046	0.084	0.131	0.189	0.263
United Kingdom	0.030	0.085	0.168	0.287	0.453	0.674
Ukraine	0.005	0.019	0.048	0.081	0.130	0.203
United States	0.017	0.048	0.087	0.139	0.200	0.272
World	**0.557**	**1.471**	**2.768**	**4.498**	**6.865**	**9.990**
GDP, real, local currency (percentage change)						
Australia	0.07	0.12	0.29	0.41	0.61	0.83
Colombia	0.04	0.06	0.11	0.16	0.23	0.30
India	0.02	0.04	0.10	0.14	0.21	0.28
Indonesia	-0.01	-0.02	-0.03	-0.06	-0.08	-0.12
Korea, R.	0.03	0.04	0.07	0.08	0.12	0.11
South Africa	-0.01	-0.02	-0.03	-0.06	-0.10	-0.16
Poland	0.07	0.12	0.29	0.41	0.61	0.83
Taiwan	0.04	0.06	0.11	0.16	0.23	0.30
Ukraine	0.02	0.04	0.10	0.14	0.21	0.28

Source: UnLink Model – National Institute of Economic and Industry Research.

6 The path to a global carbon tax

It has generally been assumed in Australia, that because the country is so richly endowed with coal, providing most of stationary domestic energy needs as well as the being the major export commodity, that it would be inconceivable to contemplate winding down the coal industry. The notion that use of coal should be significantly foregone is taken to be economic madness. Yet a literal reading of the GHG abatement requirements to avert global warming indicate that this exactly the direction in which Australia should be heading, unless emissions can be captured.

An appropriate policy view, particularly in light of a Stern type discount rate, is not that use of coal should be substantially foregone, but that it should be preserved for future generations. This is particularly the case when it is likely that an essential future use of coal will be for the production of liquid fuels. Placing a tax on coal does not diminish the implicit net present value of national coal reserves, it increases their value.

The purpose of the analysis here is to show that rather than being a threat, Australia has a window of opportunity to substantially decarbonise its economy. The revenue earned from an international coal tax can be used to invest in alternative energy production. By demonstrating its willingness to take a lead in this matter, Australia could gain the respect of the world and greatly increase the probability of other countries taking similar action for GHG abatement.

There is no precedent for a global tax, so administrative arrangements are necessarily speculative. An initial agreement between coal exporting countries could be proposed to the IPCC for consideration and the WTO for possible endorsement. Irrespective of this, it is in the interests of the exporting countries to take steps to implement the tax. Ideally the tax should be paid into a common fund and then distributed according to entitlements. It should be a requirement that the funds only be used for GHG abatement purposes. Most revenues would be paid to exporters to preserve incentives, but a proportion of funds could be paid or credited in compensation to disaffected countries.

For convenience in the above modelling analysis, a coal tax was implemented as a percentage of the coal price. In practice a tax rate would be set based on the carbon content of coal. For comparisons, at \$60 per tonne, a tax of 5 per cent of the coal price is approximately equivalent to a tax \$3 per tonne of coal, which for anthracite translates to a tax or less than \$1 per tonne of CO_2e. Hence the above simulation results, base on a cumulative increase of 5 per cent over 5 years, represent what could be achieved with a carbon tax or less than \$5 per tonne CO_2e.

The Stern Review suggests that with a target of 450-550 ppm CO_2e, the social cost of carbon can be calculated as \$25-30 per tonne of CO_2e. This equates to a tax of \$70-\$85 per tonne of anthracite. Further investigation is required, but the results seem sufficient to indicate that with carbon tax of this magnitude, a significant revenue source will be available for investment in alternative energy. Therefore the loss, or at least partial loss, to Australia of its coal industry is not something that should be contemplated with a sense or foreboding, provided the transition is handled sensibly.

For the implementation of an export tax on coal to be credible, it would need to be matched by similar domestic taxes on coal consumption. Such a scheme could operate in conjunction with emissions trading. France has recently announced plans to impose a tax on coal. Japan and Sweden have had such taxes for some time. According to the French plan, coal would be subject to a levy of 1.19 euros per megawatt hour of energy produced. France also suggested a possible "carbon tax" on imports of industrial goods from countries that refuse to commit to the Kyoto protocol after 2012. Similar such measures could also be used to encourage compliance with a global carbon tax, via selective import levies.

7 China's coal reserves

Whatever the prospects of averting the disastrous consequences of global warming may be, the policies adopted by China will be critical. China's projected deployment of coal fired power stations currently would appear to preclude the possibility of achieving a global temperature rise of less than 2°C. The actual realisation of China's projected coal production will depend on the extent of their reserves. Estimates of China's coal reserves vary considerably. The IEA provides estimates of world reserves and production in separate tables. The reserves, production, and the implication of production quantities for reserve depletion are shown in Table 5.

Table 5 World coal reserves and production (billion short tonnes)

	Reserves	Production 2004-2030	Per cent of reserves
United States	267.6	35	13
Russia	173.1	10	6
China	126.2	97	77
India	101.9	14	13
Australia and New Zealand	87.2	14	16
World	**997.7**	**218**	**22**

Source: Based on IEA estimates, International Energy Outlook 2007.

Based on these estimates, China's coal reserves will be about 77 per cent depleted by 2030. In this case, Australia's role as coal supplier would obviously become more important, as would the role of a coal tax. It is reported that in 2007 China will be a net coal importer. It is conceivable that China's massive projected deployment of coal fired power may be occurring as a result of decentralised decision-making at the local level, without regard to long term national coal supplies. China's own national interest, it could persuasively be argued, would therefore lie in price incentives to alternative energy deployment.

Alternate estimates however put China's reserves at more than 400 billion tonnes. China's plans for future coal utilisation certainly do not indicate any great concern regarding the magnitude of their coal reserves. This would seem to indicate that the higher estimate may be the more accurate. The need for a tax to moderate consumption of coal becomes even more necessary in this scenario.

Australia's coal reserves, as shown in Table 5, are smaller only than the US, Russia, China and India. In per capita terms however, which indicate potential export surplus, Australia's reserves exceed all others by a wide margin. This again indicates Australia's unique position in world coal production.

8 Conclusion

Consideration of carbon taxes has been overshadowed by enthusiasm for trading schemes. This may have been due to an over-optimistic assessment of their benefits or because there seemed to be no feasible plan to implement an unprecedented global tax. These perceptual obstacles can be overcome by the realisation that such a tax could be implemented in stages, starting first as an export tax on coal, then extending the tax to other fossil fuels. Independently an export tax on coal could be extended to a coal tax of more general application. The advantage of this process is that national interests are served, not undermined, by those countries that, acting collectively, initiate the process.

A further perceptual obstacle to be overcome in Australia is that placing a tax on coal would not be in the national interest because it would be detrimental to the coal industry. Given the important role that coal currently plays in the Australian economy, this is concern understandable. However this perception overlooks the fact that such a tax can increase foreign earnings, not decrease them. The analysis here provides an initial quantification of these benefits of the tax.

Overcoming these obstacles may help open the future of non-carbon based energy production. It may then be recognised that investment in new coal fired power, and in increased coal export capacity, as is currently planned, is not only climatically unwise, but economically irresponsible as well.

Current knowledge of the severity of the possible consequences of global warming, indicate that the situation can justifiably be described as a global emergency. The global policy response so far lacks any proposal to adequately address the problem. The major impediment so far has been in finding a policy that will have any significant impact on plans for increased global deployment of coal fired power. Given Australia's dominant role in the world coal trade, it is incumbent upon Australia to take a leading role in finding a solution to this crisis. The proposals put forward here hopefully provide indication of the direction in which such a solution may be found.