The Secretariat,
Garnaut Climate Change Review,
Level 2, 1 Treasury Place,
Melbourne Victoria 3000
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This submission addresses some inter-related aspects of cost-effective abatement of energy sector CO_2 emissions both globally and in Australia.

If feasible the present version should replace the previous revised and edited version acknowledged by the secretariat, April 24.

The present version includes revision and expansion of the additional section (11) on distributional aspects, especially to include reference to biofuels.

My relevant experience in cost-effective abatement of energy sector CO_2 emissions has been influenced by past employment in ABARE as a Senior Economist, especially the dozen years or so spent working with technology-rich model of the national energy systems developed under IEA auspices, known as MARKAL. Since 2004, my area of research has been on political aspects of international oil and gas markets, and US foreign oil policy in particular. Relevant publications are included in the References list.

To my knowledge there are no areas in which I'm not in full agreement with the reports and interim reports so far published by the Garnaut Climate Change Review.

However, in several broad areas my supplementary comments may be useful. They mainly concern Australia's stance with respect to international efforts on climate change and hence foreign policy aspects.

The role of 'market instruments' such as Pigovian responses to external costs, especially CO_2 taxes and pricing is fully recognised. Other forms of government intervention should be confined to cases in which (energy) market failure can be demonstrated and effectively addressed. The case of end-use energy savings is a controversial one in this regard and some aspects are addressed in this paper.

However, especially in the international sphere, energy security is also important although frequently not well-specified objective that may also be a constraint in meeting emission abatement objectives. Two examples are considered (i) the bogus campaign in the US to 'set America free' of 'foreign' oil; (ii) the desirability of enhancing the perceived supply security of natural gas, especially from the Middle East, given that gas has a potentially important role in abating the alarming potential increase in CO_2 emissions from projected increase in coal-fired electricity generation, especially in China but also India.

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Submission to Garnaut Climate Change Review

Contents

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Executive Summary

1. Abating emissions through end-use energy savings and improved energy efficiency
Evidence-based modelling and theory would suggest that considerable scope exists for improved energy efficiency, and end-use energy savings generally, to produce cost-effective CO_2 abatement. For example, recent economic modeling by the IEA suggests that as much as 44 per cent of an abatement target by 2050 (60 per cent total abatement) would be from end-use energy savings mainly induced by higher prices and by pricing CO_2.

2. GDP and income growth constrained by abatement policies: reciprocal impacts
Arising (in part) out of the energy efficiency issue are some aspects of the reciprocal impact of emission abatement on GDP, hence on national income hence on demand for energy services. Some questions about GDP and income effects arising from the Stern Report are noted.

3. Addressing external costs of urban road transport—implications for climate change
Private vehicles have been a major source of CO_2 emissions but one in which the main fuels, usually derived from oil, have long been subject to tax, albeit at highly variable rates internationally. In particular, rates in both of the two major CO_2-emitting countries (US, China) are low by world standards and also insufficient to meet relevant external costs. Rates also remain low in other thriving economies in the developing world and among the oil-rich states of the Middle East. Changes in these rates will have major impacts on CO_2 emissions.

4. Conflict with a campaign for oil import independence in the US Policies promoting 'oil independence' (or as 'setting America free' from 'foreign' oil) have been strongly promoted recently. This policy objective is both dubious in its own terms and in marked conflict with cost-effective CO_2 abatement

5. Secure international trade in natural gas: important in abating CO_2 emissions as an alternative to coal in electricity generation

   The use of natural gas in combined cycle gas turbines (CCGTs) is a key non-nuclear 'bridging technology' alternative to coal-fired capacity in the generation of baseload electricity, having only half the CO_2 emissions per kWh of the latter. It is potentially an immensely important option for China and India using natural gas from West Asia.

6. Distorted markets for natural gas in transport

   On a level-playing field but with CO_2 priced, natural gas would be more cost-effective in abating CO_2 emissions from otherwise coal-fired electricity generation than it would be in substituting for oil in fueling vehicles. Natural gas should not be directed, via distorted markets, for use as a substitute for oil as a vehicle fuel. Exempting natural gas from a retail tax when used in road transport would exemplify such a distortion. Given supply-side limits, an unwanted result would be to tie the price of gas to that of oil, hence tending to price gas out of input markets for electricity generation.

7. Stances of Australia, 'Chindia' and multiple roles of the US in the abatement effort
Based on pre-election statements of the Presidential candidates, a US Administration

replacing that of GW Bush might be more likely to exercise cooperative leadership in multilateral approaches to addressing greenhouse gas emissions abatement, first and foremost by itself adopting mandatory targets. This process may perhaps have been helped by the new exemplary stance adopted post-November 2007 by Australia (previously the only other OECD hold-out *vis-à-vis* ratifying the Kyoto Protocol).

However, even if it does adopt a more ambitious domestic target for greenhouse gas emissions, and even if it concurrently engages China and other states in doing likewise, the US could still obstruct cost-effective approaches in other respects, for example, by obstructing the free international trade in natural gas noted above.

This process cannot be divorced from the related question of US relations with China not only with respect to gas supplies but in the governance of international energy markets generally and in cooperatively addressing 'dangerous' climate change.

Obviously, onus is also on China to address cooperatively these same linked issues.

8. <u>Attitudes of the petroleum-rich Middle East states in climate change negotiations</u>
There could be multiple advantages from more closely engaging the Middle East member-states of OPEC in addressing the climate change problem. These states have something to gain from reforming domestic energy policies and from promoting exports of the clean fuel natural gas, both of which contribute to emission abatement.

Assuming oil importing states adopt optimal policies with respect to both transport externalities and cost-effective CO_2 abatement, oil-rich member-states of OPEC, Middle East and otherwise, will experience lower growth rates in oil revenues (prices and volumes) but this could be offset by increased revenues from natural gas exports.

Negotiated resolution of US differences with Iran would do much to make West Asian natural gas more readily and securely available internationally and at a competitive price.

9. <u>Research, development, demonstration and innovation</u>

The 'non-appropriability' case for RD&D support by government rests on the notion that private firms will otherwise under-invest because of their inability to capture a sufficient share of the potential benefits of investment in RD&D or because perceived risks are too great, time horizons are too long or the certainty of sufficient future emission prices is too low. This much is clear at least at the level of generality, but less clear is the appropriate source of funds and the allocation processes and criteria.

10. <u>Climate change policy and 'energy security' policies</u>

Two distinct references have been made in this submission to what might be described as 'energy security' policies. 'Setting US free' of oil imports was rejected as costly distraction or worse. However, securing stable, diversified and competitive international markets in natural gas was identified as of key importance in cost-effective abatement globally.

The US has an important role in this by normalizing its foreign policies with respect to the oil-rich states of the Middle East (Iran in particular).

11. The ‘diabolical’ equity issues in climate change policy

Professor Ross Garnaut has referred to three ‘diabolical’ fairness problems that have to be overcome in a successful public policy effort on climate change (Garnaut 2007). These are related to fairness of the incidence of costs and benefits in respect of the three types of cost (averting ‘dangerous’ climate change; the incidence of damage from human-caused climate change that cannot be averted; the costs of adapting to such climate change.

Such costs will occur in the following dimensions: (i) intra-nationally; (ii) internationally; (iii) inter-generationally. This gives rise to a matrix of nine possible cases of interest. However, in this submission just some selected cases are considered:

- As to intra-national fairness, there may be insights from the case of universal, compulsory national health insurance systems such as Australia’s Medicare.
- International issues of fairness include (i) the leadership responsibilities of OECD states as both the past and present key polluters on a *per capita* basis and (ii) the greater vulnerability of the poorer nations which are also less able to fund and implement such adaptive measures as may be necessary.
- Intergenerational fairness includes analytical and ethical issues associated with time preference (for the less remote future), otherwise known as the discounting process.

End-use energy savings and energy efficiency improvement in abating emissions

Reduced energy use (relative to business-as-usual) is an important way of abating CO_2 emissions from the energy sector. This mechanism complements abatement occurring as a result of shifting to less CO_2-intensive fuels and technologies, including but not limited to renewables. Such abatement can occur in direct response to the pricing of emissions but it can also occur additionally from cost-effective government intervention or other forms of correction to forms of 'market failure' (for example, the 'principal-agent problem') in energy markets. Such 'market failure' can discourage energy saving and use of more energy-efficient technologies and techniques that would also abate emissions.

<u>Politicising policy choices for and against energy saving</u>

Any least-cost combination induced by a combination of emission pricing and other proven cost-effective interventions must contain some mix of energy saving and energy switching. The relative importance of such roles and mechanisms can become politicised.

For example, vested interests can influence policy ('rent-seeking') either in support of or in opposition to any interventions that may supplement CO_2 pricing.

The influence of such vested interests may well be biased on the supply-side in at least two ways that inhibit promotion of energy savings relative to other forms of adjustment: (i) toward particular supply-side interests and technologies alleged to be 'greenhouse friendly', for example, corn-based ethanol in the US, or nuclear power — for example, arguments cited in Bryce 2008); (ii) opposed to intervention promoting energy savings in relation to their own product where that is viewed as adversely affecting profits — for example, opposition of less innovative US auto and oil companies to tightened fuel efficiency standards or to increased taxes on oil-based transport fuels (Goel 2004).

Arguably, the national industry structure is such that there is not a substantial voice or strong lobby group promoting energy efficiency. Rather, energy-efficient 'options' are typically available mainly within the existing wider product ranges of existing firms.

This debate also includes controversial theoretical and empirical issues including: (i) the extent to which the above-noted forms of market failure actually involve a significant bias against energy saving and energy efficiency; (ii) the extent to which such market failures can be corrected cost-effectively, and by what means; (iii) under what circumstances the energy-saving effects of improvements in energy efficiency can be eroded by market responses—the so-called 'rebound effect' or 'backfire effect' (this terminological distinction being important, as shown below).

Considerations external to CO_2 abatement but relevant to choices between energy saving *versus* energy switching have also enlivened recent debate. These include not only other types of external cost (exemplified by the case of urban road transport considered below) but also major income distribution issues. An example of the latter is a global food (price) crisis arising in part from the pre-emption of arable land and other resources for biofuels subsidised or tax-exempt for use in private transport rather than for food crops.

<u>Definitional and conceptual issues.</u>

First, economic (or 'allocative') 'efficiency' needs to be distinguished from 'energy efficiency'. Improving one need not imply improving the other. Increasing energy efficiency (that is, simply reducing energy inputs for a given output) is not necessarily allocatively efficient. It also depends on what the cost is, inclusive of the cost of emissions abatement. Other things being equal, the notion that economic efficiency improvement is desirable is almost tautologous. But even here we should focus on the notion of 'social efficiency' which means to ensure that externality effects are ‘internalised’, for example, by Pigovian taxes, and also (perhaps) to ensure that (some) losers may be compensated.

A second semantic point is that improving energy efficiency is not the same thing as saving or ‘conserving’ energy. First, there are other ways of saving energy that have nothing to do with enhancing energy efficiency at all. For example, due to the increasing price of energy services or to more frugal behaviour by consumers turning down heating knobs or foregoing unnecessary trips, buying smaller cars, or increasing capacity utilisation rates (for example, car-pooling). A second disjunction between improving energy efficiency and saving or ‘conserving’ energy is exemplified by an extreme case of the ‘rebound effect’. (See next section.)

A distinction arises between energy efficiency improvement or energy savings occurring exogenously (or initiated outside markets) and endogenous improvements in energy efficiency due to changes in price signals.

The exogenous case is exemplified by (i) autonomous technological progress that happens to be energy-saving or (ii) cost-effective government policy responses to well-defined forms of market failure that may inhibit energy efficiency or energy savings.

The endogenous case is exemplified by energy savings and energy efficiency induced by (a) rising primary energy price trends (especially, the stepwise increase in oil prices since 2004) and by government intervention in markets: not only pricing of CO_2 but also from higher taxes on energy based on other external costs but nonetheless important in suppressing CO_2 emissions. These latter include not only the primary effect of the CO_2 directly but also its secondary effects for example, inducing more capital-intensive or resource intensive electricity generation technologies.

These price-induced mechanisms include (i) substituting capital inputs for energy inputs in energy-using devices; (ii) increasing the price to the consumer of energy services (iii) implying a zero or negative net economy-wide income effect; (iv) in the longer run by inducing technological change that saves energy or improves energy efficiency. (CO_2 pricing will of course also have a wide range of other emission abating effects such is inducing switching to less carbon-intensive fuel and technologies.)

<u>Rebound effects and backfire effects</u>

The rebound effect simply refers to the operation of markets in diluting some of the initial gains from energy efficiency improvement that might be expected simply on ‘engineering’ criteria. The mechanisms generally assume a case in which the energy efficiency improvement reduces the unit cost of the associated ‘energy service’ (for example km traveled by car). In such a case a negatively sloped demand curve will imply an expanded consumption (more km traveled per year) and this can contribute to offsetting the original energy savings. Again assuming a reduction in real costs, this mechanism can be supplemented by an income effect that is economy-wide and which in turn promotes increased energy use

Some ‘rebound effect’ offsetting energy savings (and emission abatement) generally occurs when there is an improvement in energy efficiency. At issue is its sign and extent. It will be argued below that it can range from being effectively negative (when all effects of policy are considered) to being such that it more than offsets the savings due to the initial energy efficiency improvement. In this latter case, a convenient term is ‘backfire effect’. One form of obfuscation (relevant to the politicization noted above) is in effect to assert that all ‘rebound effects’ are ‘backfire effects’. This is done semantically by failing to acknowledge the latter term.

Thus, the mere existence of a rebound effect should not be controversial given the normal operation of markets. However, empirical evidence suggests that this effect is generally far from fully negating or offsetting the energy savings and hence emission abatement giving rise to a ‘backfire effect’. The literature generally indicates that rebound effects reduce initial energy savings to a varying extent but ‘not high enough to mitigate the importance of energy efficiency as a way of reducing carbon emissions’ (Greening, Greene & Difiglio[1] 2000: 399; Sorrel and Dimitropoulos[2] 2008: 645).

Second, the effect (even in its partial form) depends on the relevant initiating energy efficiency improvement being costless or even negative cost. This will not be the case in some of the most policy relevant cases, where energy efficiency improvements are induced endogenously, that is, from pricing emissions or from higher taxes on energy or energy services. Further argument is below and in the Appendix.

Nonetheless, where significant rebound effects are observed it may be open to address these with appropriate policy responses. This may not mean ‘more intervention’, just better policy design.

<u>Market failure and allegedly costless energy efficiency and energy saving</u>

The possibility of a significant rebound effect is greater where energy efficiency is obtained at zero or negative cost. This includes both autonomous technological progress that happens to be energy saving; (ii) (Government) intervention to address market failure that is inhibiting energy saving of energy efficiency. Theoretical and empirical aspects of

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[1] These authors (2000: 399) conclude:

> For the energy sectors of the US economy for which studies are available, we can conclude that estimates of the rebound are very low to moderate. The upper estimates, however, indicate a rebound effect that is not insignificant. Even these upper bound estimates, though, indicate that most or all of any reductions in energy use or carbon emissions are not lost to changes in behavior. This leads us to the conclusion that the rebound is not high enough to mitigate the importance of energy efficiency as a way of reducing carbon emissions. However, climate policies that rely only on energy e$ciency technologies may need reinforcement by market instruments such as fuel taxes and other incentive mechanisms. Without such reinforcements, a significant portion of the technologically achievable carbon and energy savings could be lost to the rebound.

[2] These authors (2008: 645) conclude:

> Many empirical estimates of the direct rebound effect are based upon price elasticities and rely primarily upon historical or cross-sectional variations in energy prices. The paper has argued that such studies could potentially overestimate the magnitude of the effect. Factors contributing to this include: the asymmetry of price elasticity estimates; the anticipated positive correlation between energy efficiency and other categories of input costs, notably capital costs; the role of price induced efficiency improvements; the endogeneity of energy efficiency; and the anticipated negative correlation between energy efficiency and time efficiency.

such market failure have been thoroughly debated ((Hinchy *et al.* 1991; Jaffe & Stavins 1994; IEA 2007).

Price-induced energy efficiency improvement, savings in energy use and energy services
Price-induced savings in energy use and energy services exist as the result of pricing CO_2 emissions or otherwise increasing energy taxes (for example, retail taxes on transport fuels). Such price-induced effects can involve several mechanisms (i) encouraging the substitution of capital for energy (for example, promoting greater use of hybrid cars relative to otherwise similar standard gasoline cars, or compact fluorescent light bulbs (CFBs) rather than standard incandescent bulbs or passive solar design in houses involving more and better insulation, double-glazed windows etc.)

The relative importance of end-use energy saving compared with supply-side adjustments as indicated by technology-rich modelling simulating global markets has been highlighted in recent global modelling by the IEA using a database with richly specified set of supply-side and demand-side technologies and simulating efficient markets operating over the long-run to 2050 in a global energy system model. As discussed below these end-use energy savings would be largely driven by higher prices for energy and by pricing CO_2 emissions.

Savings in energy can be costless or even involve negative costs. This can be due to (i) exogenous factors such as autonomous technological progress or (ii) government interventions cost-effectively correcting genuine 'market failure' in energy markets (Hinchy *et al.* 1991). Under either of these circumstances of costless or negative-cost improvement ion energy efficiency it is possible that a 'rebound effect' will somewhat dilute the effects of such improvements in energy efficiency.

Addressing rebound effects or not
As indicated, the mere occurrence of rebound effects is a normal market reaction when the effect of the energy efficiency improvement is to reduce unit costs of the relevant energy service, with its extent dependent on various price and income elasticities of demand, market structures etc.

There should be no need or presumption that such effects require 'correction'. However in some in cases where significant rebound effects are observed it may be cost-effective to address this with appropriate policy responses.

This may not mean 'more intervention' but better policy design. Perhaps a case in point is policy relating to CFBs. The latter are often likely to be cost-effective without any intervention given (i) declining trends in capital costs and (ii) their application in locations where higher utilisation rates are required. However, the United States' CLEAN Energy Act of 2007 is understood to include a provision banning standard incandescent light bulbs by a certain date (CongressPedia 2007; Lavelle 2007). If this were to mean removing the option of low-cost but less energy-efficient bulbs in the low utilisation applications then a result be the increased dispersion of lower running cost CFB that would be left switched on for much longer periods. This may suggest a second look at that form of the proposed standard.

Declining historical importance of rebound effects?
Mention was made of the alleged historical importance of rebound effects over a long period characterised both by strong and prolonged expansion in energy consumption but also both energy efficiency improvements and declining energy prices. However, attributing expanded consumption to the energy efficiency improvements alone can be fallacious (see **Appendix** for discussion of the so-called 'Jevons paradox'). Further some of these long-standing historical trends are likely to be changing irreversibly, despite technological progress.

First there are decreasing returns from extraction of primary energy and then there is a bottoming out of technological improvements for example, in fuel efficiencies. For example, the cost of electricity generation is now increasing as energy efficiency improvements have bottomed out, first in coal-fired generation and then in natural gas. Similarly, it is widely believed that the real price of oil is unlikely to return to pre-2004 levels and that this rising trend reflects increasing costs of exploration and extraction.

A second factor likely in the future to significantly increase the price of energy to consumers is the abatement and pricing of CO_2 emissions. This has two mutually enforcing effects: (i) encouraging the introduction and use of technologies and forms of energy that are less CO_2-intensive but more costly; (ii) the price of the CO_2 emissions themselves will be to some degree passed on to consumers.

These two sets of price-related factors operating together will tend to reduce energy use by several mechanisms: (i) encouraging the development and use of more energy-efficient equipment; (ii) reducing the consumption of energy services because of the price effects just noted; (iii) via an income effect reducing the consumption of energy and energy services along with other goods and services.

In summary, the above circumstances make it unlikely that significant rebound effect will exist in case where the improvements in energy efficiency are price-induced. This is because the price and income effects would tend to be muted if not reversed compared with the cases of exogenous improvement in energy efficiency.

Major cost-effective end-use energy saving indicated by IEA analysis
End-use energy savings and energy efficiency improvements can be viewed collectively as 'demand-side' adjustments. As such they can be compared with supply-side adjustments often about switching to less CO_2 emission-intensive technologies and fuels. The roles of each kind of adjustment are indicated in economic modelling of emission abatement. One such modelling exercise conducted by the IEA (2006a) simulated global markets and allowed choices among a rich database of technology and fuel options.

The particular reference is to the IEA Report *Energy Technology Perspectives: Scenarios and Strategies to 2050* (2006a)[3]. This Report is understood to have been based on a form

[3] The model used was a form of MARKAL with a global scope and disaggregation incorporating a richly detailed specification of technological options, much richer than can be specified in macro-economic or GE models. In the associated press release IEA Executive Director Mr. Claude Mandil stated:

> Accelerating energy efficiency improvements alone can reduce the world's energy demand in 2050 by an amount equivalent to almost half of today's global energy consumption. To achieve this, however, 'governments, in both OECD and non-OECD countries, must be willing to implement measures that

of modelling that involved endogenously pricing CO_2 to the extent necessary to achieve the required emission abatement by 2050.

This IEA research analysed cost-effectiveness of technologies that could together reduce global greenhouse gas emissions as at 2050 by 60 per cent. Not all these scenarios included nuclear. In the case where new nuclear was permitted, it was found to account for only 6 per cent of the total emission abatement compared with 44 per cent from improved end-use energy efficiency, with the remaining 50 per cent from a variety of other technologies. http://2050.nies.go.jp/200606workshop/presentations/6-3Taylor.pdf.

Stern also refers to this IEA report (Stern 2007: 263-64). Care is required here because the IEA also conducts simulations using its macro-economic model of the global energy system and publishes these in its annual World Energy Outlook (2006b). This latter report is also referred to by Stern on the very same page (2007b: 264). In referring to that WEO report, Stern notes that the IEA's so-called 'Alternative' policy scenario

> … entails more investment in energy-efficient infrastructure, but less investment in energy production and distribution. These effects broadly cancel one another out so investment requirements are about the same as in the reference case.

The IEA's WEO discussed how this Alternative scenario is to be brought about, implying that strong policy interventions will be necessary but that the nature of these is up to the countries concerned. This is understandable given both the politics of the IEA and the nature of its global macro-model. However a cautionary note is relevant. It cannot be assumed that all interventions designed to foster energy efficiency are cost-effective, and in particular, cost-effective in abating CO_2 emissions. Pricing emissions is one means by which cost-effective energy efficiency be induced cost-effectively and that would seem to be the mechanism modeled in IEA's above-noted *Technology Perspectives Report* (2006a).

However, where the rationale for energy saving policies is market failure then care may need to be taken to ensure that the particular policy responses chosen are optimal rather than simply prompted by vested interests such as the biofuels sector or vehicle manufacturers[4]. The question of whether more capital-intensive but less energy-intensive

encourage the investment in energy-efficient technologies'. http://www.iea.org/Textbase/press/pressdetail.asp?PRESS_REL_ID=180

[4] General discussion of vested interests is in Sylla (2006). The successful lobbying power of the US corn-based ethanol industry is well documented, for example, in Taylor & Van Doren (2007), Pimental (2003), Carney (2000). Motor vehicle companies lobby against introduction or tightening of fuel efficiency standards, such as CAFÉ (the US Corporate Average Fuel Efficiency Standards) or higher gasoline taxes.

In regard to the CAFÉ standards and the US neglect of demand-side approaches, he further notes (471):

> Corporate Average Fuel Economy (CAFE) standards in 1975, several studies indicate that their effect was probably minimal since automakers had in any case begun designing more fuel-efficient vehicles due to high gasoline prices in the post-1973 period. Moreover, the standards have not been tightened in the past two decades and the original 'light truck' exception clause has allowed sports utility vehicles to proliferate. Thus, while other developed countries set about restructuring their economies to differing degrees in line with the reality of high oil prices, the US favoured an international response which included diplomatic efforts and the formation of the International Energy Agency in an effort to counter OPEC's actions. In short, the nexus of the policy response was supply-based, not demand-based.

technologies entail a significant net cost (implicitly denied by this IEA WEO Report and accepted by Stern) is also connected to the appropriate discount rate to be used in the analysis (or loosely, 'pay-back period')

Greenhouse gas emissions abatement and income costs and effects

Analysts of the economics of long-term emission abatement such as Stern (2007: 265) have indicated that the required emission abatement over a period such as to 2050 will entail a reduction in GDP in a year such as 2050 by an amount such as 1 ± 2½ per cent of annual global GDP. This figure can be assessed relative to a business-as-usual rate of growth in GDP which is not stated by Stern. If the latter were say 3 per cent per annum then the loss of GDP by 2005 appear minimal: equivalent to a maximum delay of the order of one year in attained global GDP!

Questions arise out of this part of Stern's discussion. For example, his cost estimate refers to meeting a global abatement target corresponding to attaining an atmospheric level of around 550 ppm CO_{2e} ('stabilising trajectory') (2007: 239).

But in relation to the tighter but possibly more policy-relevant target of 450 ppm CO_{2e} Stern says only that this 'target is likely to be unobtainable at reasonable cost'. His chapter 10 elaborates on this vaguely worded contention. In chapter 10, which draws on a survey of the main macro-economic models, it is stated (2007: 276) that

> In general, model comparisons find that the cost of stabilising emissions at 500-550pmm CO_{2e} would be around a third of doing so at 450-500ppm CO_{2e}.

Does this imply that a cost of up to three times 2½ per cent (= 7.5 per cent) of annual global GDP is deemed not 'reasonable'?

On the contrary, even this proportion of a potential GDP that has been assumed exponentially increasing may not in itself seem unreasonable, especially if projected damage costs of 'dangerous' climate change itself are a serious consideration to weigh in the balance by then.

There is thus an uneasy tension in Sterns results (to say the least) between a more lenient target held to be available at negligible (or even negative!) cost and a perhaps necessary target the cost of which he treats with far greater concern.

These cost estimates are global ones but if developing countries are to be allowed upper limits on national emissions implying some degree of catch-up in living standards then costs borne and GDP growth foregone must be presumed significantly greater in the OECD countries. What are the implications of this? How can such targets be achieved while still ensuring the stability of the international economic system?

What of the debate between those who argue that moderating economic growth, especially in the OECD economies, must be 'part of the solution/ *versus* those who argue that significant resources must be made available or created so as to ensure availability of the new less emissions-intensive productive assets so that targets can be met?

Resolving this apparent dilemma presumably involves making a distinction between private income streams (which are translated into demand for private energy services) and potential production as a whole which through taxation and otherwise can be directed to transforming productive assets in the direction of reduced energy and CO_2 intensity.

Addressing external costs of urban road transport: implications for climate change

Private vehicles have been a major source of CO_2 emissions but one in which the main fuels, usually derived from oil, have long been subject to tax, albeit at highly variable rates internationally. In particular, rates in both of the two major CO_2-emitting countries (US, China) are low by world standards. The US rate has been shown insufficient to meet even non-climate-related external costs (Parry & Small 2006)[5]. Rates remain far lower again in major emitters among the developing countries such as China, India and Indonesia and also in many of the oil-rich states of the Middle East[6].

This anomaly can be corrected by increasing this rate of tax in these countries such that it moves toward addressing relevant external costs and probably to rates closer to those applicable in Europe and Japan.

Likely CO_2 penalties would be a relatively small part of retail taxes on oil-based transport fuels[7]. Their policy rationale is mainly in correcting local and regional externalities[8]. These latter are at least as acute in the congested and air-polluted cities of developing Asia as elsewhere.

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[5] In comparison with the much higher UK rate which they found to exceed their measure if external costs.

[6] Goel 2004: 469) comments on diversity in fuel tax rates:

> The main reason behind the price differential is fuel taxation which, at around US$0.10/litre in the US, is a fraction of that of countries such as the United Kingdom (US$0.85/1), Japan (US$0.40/1) or Austria (US$0.60/1). The resultant lower price manifests itself in many ways in the short, medium and long term. It accounts for why Americans drive 136 per cent more kilometres annually than the average German or 53 per cent more than the average Canadian.16 It leads consumers to buy less fuel-efficient automobiles, such as light trucks or sports-utility vehicles, instead of smaller cars or motorcycles. It partially accounts for the comparatively lower rates of inter-city and intra-city transit use in the US. In the long run it undoubtedly plays a role in the very way cities are built. American cities typically sprawl out significantly more than their European or Asian counterparts; compare Detroit at 10 persons/hectare versus London or Paris at 50–75 persons/ha or 500–1000 persons/ha in some Asian cities.

[7] Sterner (2007):

> In the trading sector, the marginal cost of emitting carbon is the permit price which is in the region of 20 $/ton which is not much compared to the highest gasoline taxes which are of another order of magnitude ($1 per litre or 300 $/ton CO_2. Motoring is currently taxed at a very much higher rate than heating or industrial use of fossil fuels in Europe. If we are to reduce fossil carbon emissions it is vital to keep up the pressure on transport fuels and at the same time raise the price or increase the stringency of the instruments used for the other sectors. … much has been achieved by transport fuel taxation in European countries (and others with high fuel taxes): the effect of gasoline taxes on global carbon emissions makes it a significant instrument of climate policy. The bottom line is that carbon emissions are essentially cut by more than half by introducing a long run policy of high taxes that raises the consumer price by a factor of around 3. This is basically the difference between the USA and Europe.

[8] In fact the rationale has a lot to do with the efficiency of these taxes as revenues given the combination of broad base and price inelastic demand in the short-run (but significant enough in the longer run to address the externality issues. Stevens argues that developing countries will be increasingly drawn to fuel taxes mainly because of their need for government revenues (2005: 136). He adds that 'the result could be a dramatic reduction in oil intensities over the coming 20 years'.

Indeed, it is also important that consequent revenues are not 'hypothecated' that is, used to subsidise highway construction, thereby encouraging (without adequate analytical basis) private transport-intensive and hence energy-intensive urban forms with inadequate public transport. However, no presumption exists that all forms of private transport is necessarily always more CO_2-intensive on a passenger-km basis than so-called 'public transport'.

A policy of restraining consumption of transport fuels through higher rates of tax and enhanced energy-efficient vehicles will tend *inter alia* to reduce oil imports. However, such a demand-side policy would not generally be designed just to reduce imports of conventional crude oil as their primary objective. It is important to avoid confusion of thought between policies designed to reduce *consumption* of environmentally damaging energy (which includes transport fuels from whatever source) and policies discriminating just against *imports* of conventional crude oil.

Conflict with a campaign for oil import independence in the US

Historically, such 'protectionist' or even autarkic oil policies are not new but their rationales and pretexts are different now from what they were in the 1950s and 60s[9].

These policies have been promoted especially by a group of so-called 'oil hawks' but have also attracted a wide following even from those with very different views on foreign policy. This campaign (not yet reflected in official policy) appeals to largely irrational feelings of 'oil insecurity' (Maugeri 2006: 259-70) that perceive an 'oil weapon' that in fact does not exist—and historically has only been effectively wielded by the US superpower itself (notably in WWII).

The real objective of the 'oil hawks' is to cause a collapse in oil export revenues by restraining demand for oil and replacing it with some (hi tech) alternative. This approach is viewed as part of a 'war on terror' pursued by other means (Woolsey 2002; Podhoretz 2007, 2005; with critiques by Huber & Mills 2005; Bryce 2008a,b).

Despite the claims of some high profile commentators (Thomas Friedman 2007), this policy direction is both misconceived in its own terms and, in the climate change debate, is a red-herring or worse.

Even if greater US oil independence were to bring about declining export revenues for the oil-rich states of the Middle East it is not clear that this would reduce a terrorist threat. These states do not have economic power or aspirations analogous to adversaries in the WWI, WWII or the Cold war. In stark contrast with those adversaries[10], Iran (with a

[9] In that period, the pretexts were also about US national security but this claim did not stand up against counter-claims that the policy of quotas on imports encouraged the more rapid depletion of US oil resource (a so-called 'drain America first' principle). More plausibly, the policy was designed (i) domestically to protect Texan and other high-cost US producers and to allocate production among these; (ii) to put a floor under the international price of oil in circumstances where its marginal extraction cost was much lower in the Middle East. This policy became redundant as (i) US production peaked in 1970 and declined thereafter (with a secondary peak reflecting Alaskan production); (ii) OPEC took over the role of providing a price floor, post-1973.

[10] As pointed out by Auerswald (2007: 130).

population of 80 million) is only the world's 22nd largest economy and Saudi Arabia (20 million) is 30th. The notorious acts of terrorism against 'Western' targets carried out to date by non-state Islamist movements and activists have required minimal budgets. More plausibly, such non-state terrorist movements (including those participating in regional struggles) are driven by ideologies (including nationalism) and by reactions to US Middle East policies.

The policies of US oil import independence that are thus advanced or implied are also likely to be seriously incompatible with cost-effectively abating greenhouse gas emissions. This incompatibility is because seeking to reduce imports of conventional crude oil involves not only a demand-side focus (which is desirable for reasons mentioned above) but also implies effectively subsidising supply-side alternatives to imported conventional crude oil[11]. These alternatives tend to be far more CO_2-intensive than products based on conventional crude oil (see **Table 1**). Examples include oil-from-shale or oil-from-coal or electricity from coal, for example, as used in plug-in hybrid cars or in electric cars. Adoption of the latter as an alternative to oil-based transport fuels would also tend to increase the demand for nuclear generated electricity worldwide, with its associated serious health, safety, security and intergenerational equity problems.

For reasons discussed below, using natural gas as an alternative transport fuel should not be encouraged—but presumably that option would also be ruled out under a (misconceived) 'oil hawk' policy of discriminating against imported petroleum.

Secure international trade in natural gas as alternative to coal in electricity generation

The use of natural gas in combined cycle gas turbines (CCGTs) is a key non-nuclear 'bridging technology' alternative to coal-fired capacity in the generation of baseload electricity, having only half the CO_2 emissions per kWh of the latter. It is potentially an immensely important option for China and India using natural gas from West Asia

Gas-fired CCGTs amount to a 'bridging technology' both in the sense that it can be rapidly expanded once the primary fuel is available, and also pending the comprehensive introduction of viable low carbon sources of electricity including renewables and 'CO_2 capture and storage' (CCS) assuming that technology can be made comprehensively feasible and cost-effective. Another advantage of gas-fired CCGTs is that they are especially compatible with more intermittent forms of renewable electricity generation currently available

[11] The optimal policy for reducing imports of a commodity is a tariff on that commodity but a tariff can be disaggregated into a tax on consumption at a certain rate plus a subsidy to domestic production of the commodity and of its substitutes (Corden 1980: 31):

> Some kind of external diseconomy may attach to trade as such. If this is so, in our simple model, a tariff will be the first best policy. It will be optimum to restrict trade by both increasing import-competing production and reducing consumption of imports.

This statement appears to be applied to trade as a whole but would equally apply to one commodity such as conventional oil. See also Folie & Ulph (1979: 119).

The structure of costs for CCGTs contrasts with coal-fired electricity generation in that capacity costs ($/kW) are only about a third as much with the delivered cost of fuel as the major component, a cost mitigated the high thermal efficiencies (over 50 %) obtainable from CCGTs. The latter also have the advantage, important in uncertain planning environments, of having much shorter investment lead-times and a more modular form suitable for incremental development.

The apparent economic attractiveness of CCGTs relative to coal-fired capacity thus depends on several key variables (IEA WEO 2006:364-71; Naughten 2008): (i) the discount rate or required rate of return on capital (inclusive of interest tied up in capital during construction); (ii) assumed price of CO_2; (iii) assumed price of natural gas. The IEA (2006: 370) suggests a 'break-even' CO_2 price as high as \$20/tonne CO_2 would be necessary, but this required CO_2 price could be significantly lower at higher discount rates appropriate in liberalised electricity markets, and at lower projected gas prices than those assumed by the IEA. Considered below are reasons why the IEA's price assumptions thus might be considered pessimistically high.

CCGT capacity fueled by natural gas tends to be favoured at a high discount rates more typical of a liberalised electricity markets, at a sufficient price on CO_2 given the above '50 per cent' relationship and of course given that delivered price of natural gas is not prohibitive. The IEA has assumed that natural gas prices will continue to escalate in line with its projected high price for oil and on that basis is quite pessimistic about prospects for CCGTs *versus* coal-fired capacity in its WEO for 2004. It also raises concerns about supply security of gas *vis-à-vis* other fuels.

The position taken here is more optimistic about natural gas and CCGTs with respect to China. First, it argues that liberalised markets for infrastructure will favour CCGT; second, that a sufficient price for CO_2 is imperative and will occur as long as the international negotiating context is in place and China can see a way forward in terms of technological choices; third, that internationally cooperative policy action can do much to increase supply security; fourth, the prospects for use of gas in electricity generation will be advanced by lower projected prices sensitive to demand and supply-side factors considered below.

A further important consideration, highlighted by David Victor (2006:101)[12] draws attention to the air pollution costs (and other social costs) associated with coal and coal-fired electricity generation compared with natural gas in CCGTs as a much cleaner fuel in these terms. Support for this consideration can found in the Japanese decision 20 years ago to import natural gas as LNG for use in urban electricity generation on precisely these environmental grounds.

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[12] Victor, writing in 2006, was pessimistic about a state such as China agreeing to cap its emissions but argued for 'efforts to create a club of a small number of important countries and craft the elements of serious cooperation'. According to him:

> … one solution to the problem—to identify development paths that coincide with the developing countries' interests while also reducing emissions that cause climate change—and our book project will elaborate those schemes in more detail. (Examples include clean natural gas infrastructures in China, which would help the Chinese address local air pollution problems while also cutting by half the emissions of CO2 when compared with coal.

The scale of the problem of increasing dependence on coal-fired electricity is illustrated by the case of China. **Table 2** (based on US DOE sources) draws on projections of China's electricity capacity with that of the United States.

The good news is that China is contiguous with the world's main sources of natural gas in Western Asia (75 % of proven reserves) understood as including Russia (the single largest holder) followed by Gulf states (Iran, Qatar, Saudi Arabia) and Central Asia (especially Turkmenistan) (Naughten (2008, 2007; Kalicki 2007). Increased supply diversity is possible given the option of both pipelined and LNG imports by tanker; and improved supply security can be expected as a complex, networked gas pipeline system develops.

Hence, both the future *cif* price and the perceived 'supply security' of this fuel source are important policy issues that need to be addressed. Both a competitive price and supply security will be advanced by increased diversity of supply. A later section notes the importance of US foreign policy in this regard.

Both supplies and efficient uses of natural gas will also be adversely impacted by inappropriate market interventions. One such example is heavy subsidies to domestic consumption of natural gas in countries of supply, notably Iran. Another would be heavy use of natural gas as substitute fuel in road transport. This problem is considered in the next section.

Australia is also an important source of natural gas either exported as an alternative to coal-fired electricity generation in the importing country or used instead of Australian coal domestically. This latter option includes coal bed methane (CBM) that may not be competitively exportable due to location but can be used domestically.

Distorted markets for natural gas in transport

Natural gas should not be directed via distorted markets for use as a substitute for oil as a vehicle fuel. Absence of a retail tax on natural gas used in road transport at a rate equivalent to that on oil-based transport fuels would be such a distortion (Holmes & Naughten 1993). Specifically, all retail fuel taxes applicable to oil products should also be applied to substitutes such as natural gas, ethanol or other biofuels when used as a vehicle fuel input. This is not currently the case in Australia. The reason for parity in tax rates on transport fuel (other than carbon taxes) generally is that these taxes have their rationale as a proxies for a tax on kilometers traveled rather than fuel used as such[13].

On a level-playing field but with CO_2 priced, natural gas would almost certainly be more cost-effective abating CO_2 emissions from otherwise coal-fired electricity generation than in substituting for oil in fueling vehicles. Further, given supply-side limits, large scale direction of natural gas to transport uses would tend to tie the price of gas to that of oil to gas and hence price it out of markets for electricity generation.

[13] Such taxes can be based on external costs associated with urban traffic congestion, air pollution, … (Parry and Small 2006). Here it can be assumed that other regulations equate the air polluting characteristics of different fuels. That is, new diesel-powered urban buses are required to be no more polluting than new buses using CNG.

Research, development and innovation

The ‘non-appropriability’ case for RD&D support by government rests on the notion that private firms will under-invest because of their inability to capture a sufficient share of the benefits or because risks are too great, time horizons are too long or the certainty of sufficient future emission prices is to low. This much is clear at least at the level of generality, but less so is the appropriate source of funds and the allocation processes and criteria.

With respect to innovation in abating CO_2 emissions, the role of emission pricing into the future must be at the core. Expectations about such a price are obviously critical both for short and long-term technological change but also about infrastructure decisions.

A question may also arise about institutional reforms necessary to encourage an appropriate direction and pace of industrial and other innovation and also to counter the effects of vested interests on policy. In this regard, see for example, Auerswald (2007), Sylla (2006), Baumol (2002), Schumpeter (1928), Lovins *et al.* (2004: 26-28).

Attitudes of the US, Australia and ‘Chindia’ in climate change negotiations

It had been argued by a few commentators (Hamilton 2007, Naughten 2006b-h, 2007) that Australia’s previous uncompromising oppositional stand on ratifying the 1997 Kyoto Protocol (despite allegedly meeting its strict commitments) was not an irrational aberration but instead was based in a narrowly short-term ‘national interest’ criterion with one main motivation and two logical components.

The motivation had less to do with domestic emissions and more to do with protecting future East Asian and especially Chinese and Indian markets for steaming coal. Until late 2006 the then Prime Minister’s main advisors on climate change policy were often thought to be from the mining sector (Hamilton 2007). The narrow evidence and logic for this position is summed up in the table 2 a USDOE projection for both China and the US which can in no way be reconciled with necessary levels of CO_2 abatement as established by the IPCC and Stern report. Protection of these export coal markets required Australia to

- ally with the Bush Administration in resisting Kyoto and the pricing of CO_2 emissions;
- thereby making it all but impossible politically for China and India, as the future main markets for Australian coal, to comply with Kyoto-type principles in the next round unless and until this US stance were to change.

Australia’s ratification of Kyoto now opens the way for a sharp change away from this stance, and one that, incidentally includes the CO_2 pricing that is the *sine qua non* if any serious RD&D effort is to be put into CO_2 capture and storage (CCS) that is necessary if the steaming coal industry is to have a long-term future consistent with averting ‘dangerous’ climate change.

Multiple roles of the US in the international abatement effort

Based on pre-election statements, a US Administration replacing that of GW Bush would be more likely to exercise cooperative leadership in multilateral approaches to addressing greenhouse gas emissions abatement, first and foremost by itself adopting mandatory targets.

As already pointed out, there is some risk that US policy responses on 'dangerous' climate change may be side-tracked by a bogus objective of pursuing great oil independence for the US where this is interpreted as reducing imports of conventional oil rather than reducing consumption of transport fuels from all sources. It is difficult to assess this risk but reducing oil imports has figured in campaign rhetoric and McCain appears to have some allegiances to certain 'oil hawks'.

However, even if the US does adopt an ambitious domestic target for greenhouse gas emissions and also concurrently engages China and other states in doing likewise, the US could still obstruct cost-effective approaches in other respects. For example, as Kalicki points out (2007), rational negotiated resolution of US differences with Iran would do much to make natural gas more readily and securely available internationally and at a competitive price. Currently, the US has been attempting to discourage the planned Iranian export of natural gas from the Pars gas-field to India and Pakistan via the so-called 'Peace Pipeline' (Thaindian News, 2008).

As pointed out by Kalicki (2007), by offering an alternative to Russian supplies of natural gas, opening up Iran, along with other Central Asia and Gulf suppliers to East Asia and Europe, will have the desirable effect of both enhancing supply security and diversity and also entailing more competitive markets.

Attitudes of the petroleum-rich Middle East states in climate change negotiations

The attitudes of OPEC including the oil-rich Middle East states with respect to climate change bear consideration not least in comparison with those of Australia before it reversed its previous stand and ratified the 1997 Kyoto Protocol.

It is important that the Middle East and OPEC member-states be drawn fully into to the debate not least because this process can assist in pursuit of a more rational national self-interest by these states and their closer involvement in multilateral processes generally. The opportunities with respect to natural gas export have been noted but also dysfunctional tax and subsidy policies that inter alia obstruct these trading opportunities.

Iran is the world's second largest source of natural gas after Russia. Emphasis has been given to the international isolation of Iran and its ill-effects. The roots of this isolation extend at least as far back as the covert role of the US and UK in overthrowing its elected government in 1953 in response to Iran's nationalisation of its oil industry, the latter being a practice that was to be both universalised and legitimated in the 'OPEC Revolution' two decades later.

Relations with the US have clearly not recovered since the Iranian Revolution of 1978-79 overthrowing the US-supported Shah and the chain of incidents following that.

Iran's serious offer to the US of a 'grand bargain' with 'all issues on the table' was timed 'inconveniently' relative to a US agenda in which Iran was instead to be labeled part of an 'axis of evil' (Frontline 2007). However, numerous proposals to renew serious dialogue exist, beginning with a *Council on Foreign Relations* report authored by

Zbigniev Brzezinski and Robert Gates (2004) and others more recently (Carpenter 2007, Kalicki 2007, Maher 2007).

All the major Middle East states ratified Kyoto although it must be borne in mind that as non-Annex B states they did not have obligations to abate greenhouse gas emissions under the 1997 Protocol. At first sight these states might seem to have something in common with Australia viewed as dependent on energy exports. The differences are that (i) the Mid-East exports are far less diversified, being long focused on oil but increasingly faced with excellent prospects for natural gas exports especially from Iran, Qatar and Saudi Arabia; (ii) oil and especially gas are nonetheless far less CO_2-intensive than is steaming coal.

As indicated earlier, it is by no means clear how oil and gas will fare in a more CO_2-constrained world. Pricing CO_2 will tend to expand markets for gas used in electricity generation instead of coal and that will benefit some if not all of the major Middle East producers. CO_2 constraints mean that growth in demand for oil-based transport fuels must be retarded over the longer term but any such switch will limited by fleet turnover times. A major problem lies in plans to promote ultra-cheap cars for India when these are unlikely to incorporate costly energy-efficiency features such as hybrid technology.

One policy conclusion for the petroleum Middle East is to diversify their economies and invest in human capital so that their prospects are more stable in the face of these uncertainties. This will be more possible in a more inter-connected world that also curbs the excesses of globalisation interpreted as the forced ‘open door’ for US capital: a key motif of its foreign policy that has been undiminished since the end of the Cold war.

Climate change policy and ‘energy security’ policies

Two distinct references have been made above to what might be described as ‘energy security’ policies.

The first was the US campaign to ‘set the US free’ of ‘foreign’ oil—that is, greater US ‘oil independence’ meaning independence of imported oil. It was suggested that the real motive of this campaign had to do with a misguided form of ‘war on terror’. However, its ability to mobilise support probably does not rest on any superficial plausibility of such arguments but instead on other objectives such as subjective insecurity about increasing oil imports, or the questionable notion that subsidising indigenous fuels will reduce energy costs to consumer-taxpayers. Some concerns about oil supply security may be valid. However, more rational responses involve maintaining emergency stocks (including ‘strategic reserves’) and diversified supply sources. Concerns should be much less for a commodity such as oil that is freely traded internationally.

As noted above, supply-side alternatives to imported crude oil tend to be more CO_2-intensive than oil itself—or be otherwise hazardous, for example, methanol or nuclear power. On the other hand, policies that encourage less use of oil and other transport fuels whether imported or not will also assist in abating greenhouse gas emissions. Such policies include higher fuel taxes that recognise the full extent of external costs associated with private road transport.

However, improving energy security with respect to internationally traded energy can also promote cost-effective abatement of CO_2. The case in point here was the supply of natural gas from West Asia and other sources to China and India where it can be used as a bridging fuel to reduce CO_2 emissions that would otherwise be produced by coal-fired electricity generation. The US can enhance this energy security by addressing its fundamental differences with Iran, especially by effective negotiation (Kalicki 2007; Layne 2007) thereby encouraging more diverse and competitive supply sources.

The 'diabolical' equity issues in climate change policy

Professor Ross Garnaut has referred to three 'diabolical' fairness problems that have to be overcome in a successful public policy effort on climate change (Garnaut 2007). These related to fairness of the incidence of costs and benefits in the following dimensions: (n) intra-nationally; (w) internationally; (g) inter-generationally.

In focusing on distributional issues, it is also important to distinguish (M) mitigation or abatement costs that avert some degree of climate change; (D) damage costs due to unaverted climate change; (A) costs of adapting to unaverted climate change. Thus, distributional effects can be presented as in the matrix below:

Table …Distributional and equity issues associated with 'dangerous' climate change and averting it

	Circumstances of cost		
Types of cost incidence	Emission abatement to avert 'dangerous' climate change	Damage costs associated with climate change and its effects	Adaptation costs associated with climate change
Intra-national	**nM**	**nD**	**nA**
International **a**	**wM**	**wD**	**wA**
Inter-generational	**gM**	**gD**	**gA**

a for example, 1st world *versus* China *versus* 3rd world

Distribution issues around emission abatement to avert or mitigate climate change (**M**) are important because they represent political constraints on action. Vulnerable and 'deserving' losers from abatement action (especially from pricing of CO_2) may need to be compensated if action is to proceed with necessary levels of political support. Examples include taking reasonable account of the situations and role of lower income energy consumers in Australia; and in terms of the international diplomacy, the legitimate interests of aspirational and thriving but as yet still low income economies like China.

Distributional issues around the damage costs (**D**) and adaptation costs (**A**) of actual human-caused climate are politically important for other reasons: for example, the ethics of economies like Bangladesh having to bear heavy damage cost and not being able to afford high levels of adaptation cost while at the same time being only minimally responsible for atmospheric levels of emissions.

Not all of the nine possible cases can be considered here. Instead just some selected aspects are briefly noted:

- Intra-national fairness There may be analogical insights from the case of universal, compulsory national health insurance systems such as Australia's Medicare.
- International issues of fairness include (i) in *abatement*, leadership responsibilities of OECD states as both the past and present key polluters on a *per capita* basis and (ii) in *damage* and *adaptation* costs, the greater vulnerability of the poorer nations which are also less able to fund and implement such adaptive measures as may be necessary.

- Intergenerational fairness includes analytical and ethical issues associated with time preference (for the less remote future), otherwise known as the discounting process.
- The particular case of biofuels and impact of their promotion on food prices

Each of these fairness issues is important in its own right but especially because of their consequences for the global system of cost-effective abatement and Australia's role.

Intra-national fairness and the national health insurance analogy
Problems associated with intra-national fairness can be illustrated by the fact that electricity is in many respects an essential service for all income groups. However, electricity bills must inevitably increase as an effect of CO_2 pricing, both directly and as these prices force the introduction of less emissions-intensive technologies that must inevitably involve higher resource costs than the existing technologies—given that investment decisions about the latter have simply ignored the consequences for climate change. These electricity price increases can be ameliorated over time by the purchase of more energy-efficient appliances, passive solar design houses etc, that will reduce costly consumption requirements for electricity. However, once again, it will be the more affluent who will be better able to afford such equipment and to install it sooner.

In dealing with future uncertainties involved in climate change policy, Stern has several references to insurance principles (2007: 33, 153-4, 419). However, the redistributional aspects of insurance so far have not been highlighted. Universal and compulsory systems of national health insurance exemplify such effects.

The eminent Nobel Prize-wining economist Kenneth Arrow's original analysis of the logic of such schemes was presented as long ago as 1963. He showed how the principles of *universality* (especially with respect to benefits) and of *compulsion* (especially with respect to funding, effectively from ear-marked tax revenues) could lead to a system that was not only far more cost-effective but also far more equitable than a morass of private schemes and lack of insurance such as still prevails in the US.

Thus, health expenditure accounts for 9.6 per cent of GNE in Australia (as at 2004, WHO 2008) and 100 per cent of the population are covered by a universal and compulsory scheme funded from a levy that is proportional to taxable incomes. By way of obvious comparison, is the US where a universal, compulsory system is absent, total expenditure on medical care is around 15.4 per cent (as at 2004, WHO 2008) but 40 per cent of mainly lower income people are uninsured.

Such health insurance systems are widely perceived as fair because they involve:
- equal minimum standards of basic care;
- payment generally in accord with capacity to pay (for example, proportional to taxable income);
- as to funding and services provided taken together: redistribution from the healthy to the less healthy, from rich to poor and as between age groups (for example, from youthful/ middle aged to both very old and very young).

What are the lessons for climate change policy? In political and public policy terms the particular strength of such schemes (exemplified by Medicare) was that they come to be strongly and widely accepted in the community. This was partly because of the individual rationality of the insurance principle itself, but also the conjoint cost-effectiveness that keeps overall costs down to reasonable levels. It would also have to be acknowledged that much of the equitable redistribution is less obvious to the citizenry than cash transfers would be. However, of the greatest importance must be multiple factors to do with social benefits of better individual medical care—and social solidarity itself. As Arrow has put it in a recent interview (Arrow 2005):

> … everybody should have decent health benefits. It is our social judgment that health is different from other commodities. If something is medically available, there is a presumption against denying it because of lack of income. I think that's the thing that distinguishes health from other goods. .... we're not prepared to let people suffer for lack of medical attention. No matter what their income is. And we therefore take steps. And in this case we take steps by saying we're going to have some kind of redistribution *within the system*. (emphasis added)

The more extended context of Arrow's comments is attached as an Appendix.

<u>International issues of fairness</u>

As to international issues of fairness, the key principle of abatement action concerns the leadership responsibilities of OECD states as past and present key CO_2 polluters in *per capita* terms. This mainly involves case **wM** in the above matrix. However, the willingness of nation-states to act will be tied to possible levels of damage from 'dangerous' climate change suffered by those regions. China, for example, is especially vulnerable to risks of sea-level rise and the melting of Himalayan glaciers.

This leads to another key contention about international equity: the mismatch in which the rich nations which are not only less vulnerable to 'dangerous' climate change than the poorer nations (**wD**) but are also far better placed to fund and implement the necessary adaptive measures (**wA**). As eminent US economist Thomas Schelling (2007), puts it:

> The people who will benefit [from emission abatement] will be seven-eighths of the global population toward the end of the century. They are the people who need protection against climate change that they are not yet prepared for.

Stern (2007: Chapter 20) deals with adaptation difficulties in Developing Countries.

<u>Intergenerational fairness</u>

How future costs and benefits should be discounted, if at all, in calculations relating to policy on 'dangerous' climate change has been extensively debated. For example, Stern has taken the view, consistent also with the IPCC process including the Kyoto Protocol, that costs of abatement should be subject to a discounting process in calculating cost-effective methods of abate in terms of net present values. However, since the costs of damage due to climate change involve matters of intergenerational equity those damage costs, occurring in the more distant future, should *not* be discounted.

Australia's recent decision to ratify the Kyoto Protocol can be interpreted as acceptance of this IPCC/Stern approach, leaving the US under the GW Bush regime as the only hold-out rejecting this logic, in effect arguing that since 'dangerous' climate change is so far into the future it need not be the serious concern of public policy.

A recent survey of the economics of global climate change (Lackner, Sachs, Cooper & Pizer 2006) had put it as follows:

> the UNFCCC calls for a cost-minimizing approach to limiting significant deleterious effects on natural and managed ecosystems, rather than a balancing of overall costs and benefits of

> mitigation (and adaptation). This is a reasonable approach to a situation where significant ecosystem changes due to anthropogenic climate change are assumed to have large but also unquantifiable consequences on global society. In practice, however, the United States and some other countries (*Australia, for example*) have failed to respect this approach, reverting instead to a cost-benefit test. The Bush administration has argued that the costs of mitigation would exceed the [discounted BN] benefits and has therefore rejected any specific climate targets. (italicization added—but note that this charge no longer applies to Australia)

Once again, Kenneth Arrow has recently offered a comment on the practice of Stern, Sachs *et al.*, the IPCC and others in not discounting the costs associated with the damage from 'dangerous' climate change (Arrow 2007). Having done so, he then makes the case for abatement action more robust by a recalculation in which the effects of climate change are also discounted along with the abatement actions. He concludes:

> A straightforward calculation shows that mitigation is better than business-as-usual—that is, the present value of the benefits exceeds the present value of the costs—for any social rate of time preference less than 8.5 percent. No estimate of the pure rate of time preference, even by those who believe in relatively strong discounting of the future, has ever approached 8.5 percent.

This is an authoritative response to any critics who may object to the notion of not discounting damage costs.

<u>Biofuels, food prices, other secondary effects and international application of fuel taxes</u>
Already in early 2007 significant production of corn-based fuel ethanol in the US was pushing up food prices (Brown 2007; Monbiot 2007). This was despite corn production increases. Corn's pre-emption for fuel ethanol was the combined effect of US policy (subsidies, tax exemptions, favourable regulatory decisions) but was reinforced by high crude oil prices increasing that of gasoline. Into 2008, rapid increases in grain prices internationally have become a matter of grave concern and again this has been attributed partly to major increases in production of biofuels, not only fuel ethanol but palm oil as a precursor to production of diesel fuel from biological sources.

Thus, the contention is that providing for the transport requirements of the first world, and increasingly China *et al*., will carry a heavy penalty for the low-income populations of the world in terms of higher prices of and reduced access to, grains and food generally.

With respect to policy on abatement of greenhouse gas emissions, it is important to note that on a full fuel cycle basis, biofuels are not necessarily cost-effective, even though the growth of the vegetation from which the feedstock is obtained absorbs CO_2 from the atmosphere to compensate for that emitted from vehicles in the combustion phase. This is partly because *processing* involves significant energy inputs. If these fuels are CO_2-intensive, the net favourable effect compared with oil-based transport fuels can be zero or worse[14]. Evidence suggests this is the case for US corn-based fuel ethanol.

However this may be, the current manifestation of grains crisis is clearly not due to the pricing of CO_2, though that is a logical possibility to beware of in the future, and if so would be a case of **wM**.

[14] For instance, much of the process energy in producing fuel ethanol is required to transform the fermentation product (10 per cent aqueous ethanol) to the virtually 100 per cent required for blending with gasoline.

Another source of concern is the destruction of native forests in places like Indonesia in order to produce palm oil for use as a precursor to bio-diesel. The net effects of such policies on abatement of CO_2 emissions are likely to be complex and situation-specific, and with major implications for other environmental effects (for example, soil degradation, over-use of fertilizers) as well as major intergenerational effects.

The case of biofuels involves important policy implications and lessons. First, their support in subsidies and tax exemptions, as in the US, is an effect of pork-barreling and an uneven playing field (Carney 2000). As already noted, with respect to natural gas used as a transport fuel, there is no good case, based on local and regional external costs of private road transport, for exempting biofuels from retail taxes on transport fuels.

Second, it is important for cost-effective abatement of CO_2 internationally that appropriate levels of retail taxes also be applied to transport fuels *internationally* in recognition of these external costs. Currently, these taxes are even lower in developing countries and the oil-rich Middle East than they are in the US (see fig. …). Such taxes would be over and above the price of CO_2 released in the combustion process which typically is likely to be significantly lower (per litre) than the levels of retail tax currently applicable. As previously noted, these transport fuel taxes can also provide useful revenue sources for developing countries. With these taxes also made applicable to biofuels, competitive pressure on international food prices would be eased.

Third, with adequate rates of tax on transport fuels including oil-based transport fuels, some downward pressure would be put on the international price of crude oil. This would in turn reduce the pressure on bio-fuel feedstocks and hence food prices. Middle East states would be less likely to respond by tightening supplies cartel-fashion to the extent they can concurrently develop an alternative source of export revenue in natural gas (and petrochemicals). The positive effects of exported natural gas in abating CO_2 emissions have already been discussed. In some cases—for example, Iran—there is major potential for releasing oil and gas for export as high levels of domestic subsidy are removed and appropriate rates of retail tax applied to oil-based transport fuels. This is not to under-estimate the political preconditions for such a task. In this regard, Iran's interest in full membership of the WTO is relevant and could be a factor in international negotiations.

Conclusion

The central role of 'market instruments' such as Pigovian responses to external costs, especially CO_2 taxes and pricing, is fully recognised. Other forms of government intervention may also be available but should be confined to cases in which (energy) market failure can be demonstrated and cost-effectively addressed. The case of end-use energy savings is controversial and some aspects were addressed in this submission.

However, especially in the international sphere, energy security is also important although frequently not well-specified objective or constraint in meeting emission abatement objectives. Two examples are considered (i) the bogus campaign in the US to 'set America free' of 'foreign' oil; (ii) the desirability of enhancing the perceived supply security of natural gas, especially from the Middle East, given that it has a potentially important role in abating the alarming potential increase in CO_2 emissions from projected increase in coal-fired electricity generation, especially in China but also India.

Australian policy on ‘dangerous’ climate change has become much more internationally aware.

Aspects of distributional effects of both greenhouse gas emissions abatement and of climate change were considered. These fairness issues are important with respect to gaining consent to implementation and in their own right.

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Tables

Table 1. CO_2 coefficients: selected fuels

kg/GJ	mid	lower	upper
natural gas	15.3	14.8	15.9
natural gas liquids	17.5	15.9	19.2
gasoline	18.9	18.4	19.9
conventional oil	20.0	19.4	20.6
coal	26.2	25.3	27.3
oil shale and tar sands	29.1	24.6	34.0
coal-fired electricity	65.5	63.3	68.3
natural gas-fired CCGTs	30.6	26.9	31.8

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, p 1.20

Table 2. Coal-based electricity capacity, US EIA, 2006, Reference scenario

Region/Country	History:	Projections:					av. p.a.	increment	
Capacity (GW)	2003	2010	2015	2020	2025	2030	2003-30	total	annual
United States	310	319	319	345	390	457	1.4%	147	5
China	239	348	438	531	643	785	4.5%	546	20

Source: USDOE EIA *International Energy Outlook* 2006

Figure 1. Cumulative power sector investment by type in IEA WEO 2006 Reference scenario, 2005-30 (IEA *WEO 2006*, Fig. 6.11, p. 150)

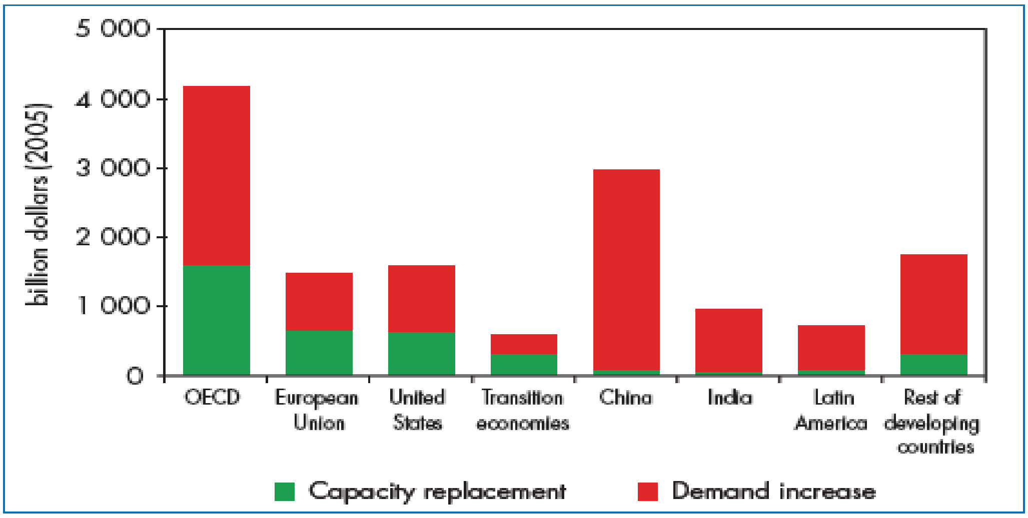
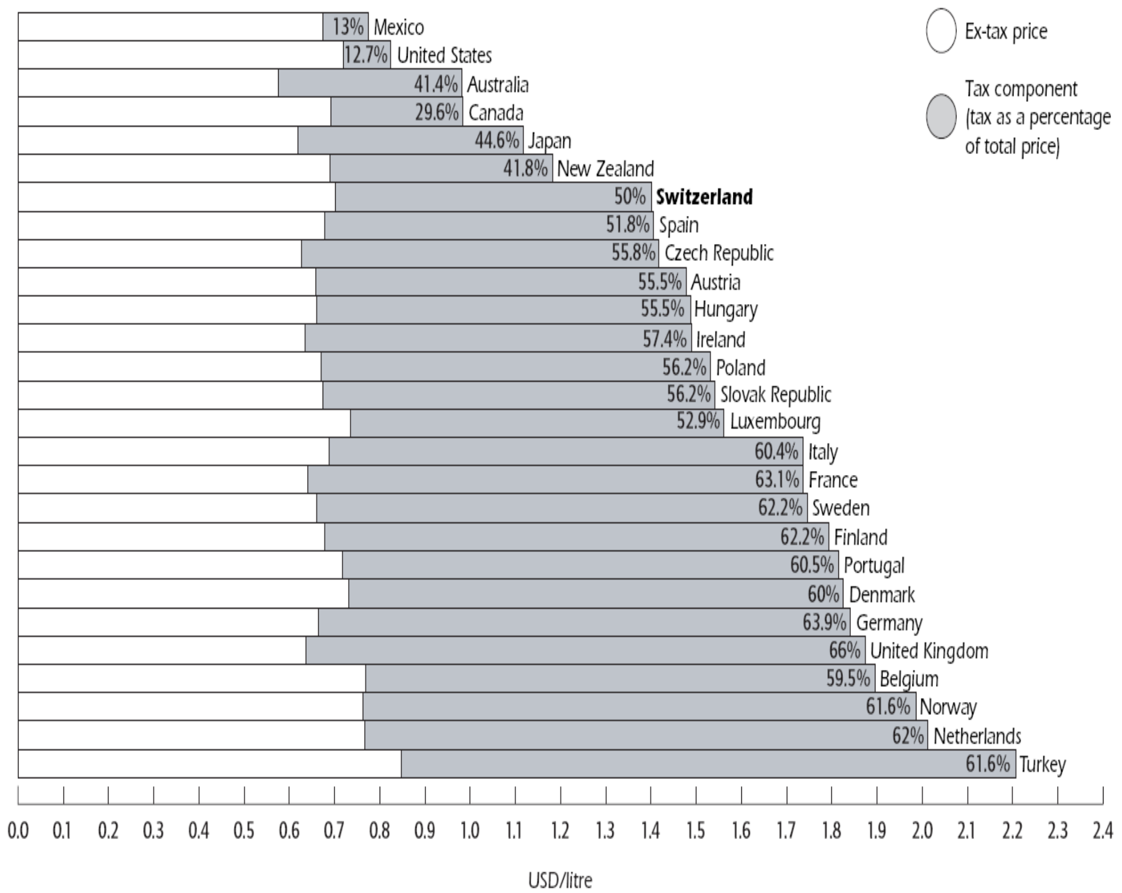


Fig. 2. OECD Unleaded Gasoline Prices and Taxes, Second Quarter 2007 (IEA/OECD)



Note: data not available for Greece and Korea.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2007.

Appendix 1. 'Rebound effect', 'backfire effect' and 'Jevons paradox'

Recall that a rebound effect may be expected in the case of exogenous (rather than price-induced) improvements in energy efficiency especially where those improvements occur at negligible or even negative cost (for example, due to costless correction of market failure' or technological progress).

The mechanisms involve reduction in the cost of delivering the relevant energy service (and reduced equilibrium price assuming the normal negatively sloping demand curve). This will mean that the savings in energy input due to energy efficiency improvement will be somewhat diluted. This mechanism can be reinforced by a real income effect operating at an economy-wide level that will be translated into increased demand for energy services due to normal income elasticity of demand effects.

However, empirical evidence suggests that such effects will generally by no means offset the full effect of the energy efficiency improvement. In cases where more than full offset occurs the term used is 'backfire' effect.

Recent literature (Smil 2003: 332; Bryce 2008d) has used the term 'Jevons effect', equating this to the 'rebound effect'. In terms of the above discussion, the assertion is more accurately about the stronger 'backfire' effect.

Thus it is claimed that the 19th century economist Jevons showed that the energy efficiency improvement typically precludes an energy savings due to energy efficiency improvement: that is, a 'backfire effect' is the norm. It will be argued that this is fallacious for at least three reasons:

- The Jevons case is misconstrued as an example of the backfire effect—other variables were of greater importance
- Contemporary empirical evidence confirms the existence of a rebound effect in the case of exogenous energy efficiency improvement but that this effect generally falls well short of a backfire effect negating the energy efficiency improvement
- In the more policy-relevant future even rebound effects are unlikely as the full costs of energy increase as the result of increasing resource scarcity and CO_2-emission constraints.

What role did this 'paradox' play in the thinking of William Stanley Jevons, and what were the historically specific circumstances that gave it an initial plausibility? Jevons was one of the 19th century founders of modern marginalist economic theory. In his book *The Coal Question* (1906), Jevons' prime concern was not the 'paradox' in itself (so labeled by later writers) but the natural limits to British coal. As an economist but also as a beneficiary of British 'free trade' imperialism he was not unaware of the existence of international trade as a means of easing this burden, albeit only temporarily.

Despite his prestige as co-founder of modern marginalist economics, Jevons was long ridiculed for this concern about what was later to be called 'limits to growth'. However, partial vindication appears to lie in emerging consensus about the end of 'easy' oil, if not about the precise timing of a peak production year for crude oil. Analogous limits to growth apply to the atmosphere's ability to absorb climate changing emissions from the energy sector. In both cases industrialisation in the face of natural limits is the underlying cause but politics and policy decisions also play a part.

As part of Jevons arguments about the scarcity of coal relative to projected markets, Jevons noted that the early electricity industry's demand for coal increased in line with marked improvements in energy efficiency in that industry. Such improvements were to become even more marked in the 20th century until a degree of saturation around energy efficiency set in around the 1970s[15]. The vast increase in the consumption of electricity over the period was associated with both (i) its growing centrality in industrialisation and the consumer economy associated with its convenience and high efficiency in use (for example, the best electric motors have an energy efficiency of over 90 per cent) well as (ii) its declining real cost, but this has been driven not only by energy efficiency improvements but also by capital-saving and economies of scale (meaning a radical reduction in capacity costs in $/kW). Hence (Jevons concluded), improved energy efficiency in itself did not diminish but had contributed to the increased rate of coal depletion. Thus, the 'Jevons paradox' was based on his mainly 19th century observations.

However, there are serious flaws in this reasoning.

First, hypothetically assume that the plateau energy efficiency for coal-fired electricity had remained at 20% instead of the 40% it actually reached in the 1970s. The unit cost of electricity would have been greater (although not that much greater in Australia where the cost of steaming coal of only 0.02 cents/kWh would be doubled to only 0.04 cents/kWh). Hence, it is plausible that the electricity consumed in that hypothetical case would be much closer to 100% of the actual levels than 50%. That is, consumers would have consumed almost as much at the higher price and lower energy efficiency. But in that hypothetical event approaching double the coal would have been used than was in fact used. So the increased energy efficiency that in fact occurred greatly reduced the coal used. That is the opposite of a rebound effect!

What is different is that we are not assuming that the vast increase in electricity consumption over time was just due to the energy efficiency improvement, which is implied in citing this case in support of a backfire effect. It was not! Rather the rapid expansion in electricity consumption was primarily due to a shift in demand due to strong economic growth and the convenience of electricity as a form of energy plus economies of scale and improved efficiency in the use of capital assets in electricity generation (that is, cost of electricity capacity in $/kW significantly declined over time).

Second, to assume that this case represents a timeless law of economics would be to commit the fallacy of reasoning from the particular to the general. The observations related concerning improvement in energy efficiency of coal-fired electricity capacity applied to the period 1870 to 1980 but after that energy efficiencies seem to have plateaued.

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[15] Very significant improvements since then, rather than energy-saving, have been focused on switching away from dependence on costly oil inputs and on capital-saving. The latter have taken the form of measures to greatly improve capacity factors and to extend asset life-times well above the previous standard 30-35 years.

However, the circumstances today are radically different from those Jevons observed.

First, we are not now facing declining energy costs as in the case of electricity in the 19th and 20th centuries. Rather, primary energy costs are increasing, as illustrated by the case of oil and gas. In the case highlighted by Jevons, namely electricity, the energy efficiency improvements that he highlighted for example, in regard to coal were exhausted by the 1970s. Further advances have occurred in the fields of CCGTs and in co-generation using natural gas. However, costs in this area will be increasingly offset by the rising cost and price of natural gas due to rising marginal costs and the link to oil prices. The price of electricity from coal and nuclear were held in check by capital-saving innovations that resulted in much improve capacity factors (from 60 per cent to 90 per cent) and longer lives including a greater emphasis on refurbishment given the exhaustion energy efficiency improvements. However, scope for further such improvements must now be largely exhausted (for example, capacity factors cannot improve much beyond 90 per cent.

Second, consumer behaviour in such a 'greener' long-term scenario must also reflect policies intended to avert climate change, especially prices on CO_2 emissions. These prices will both encourage the development and retention of more energy-efficient technologies and also tend to offset any rebound effects. Both the generally higher resource capital costs of such technologies and the price of emissions itself will tend to increase the price of energy services faced by consumers, thereby reducing demand, assuming the normal negatively-sloping demand curves. Electricity technologies constrained by CO_2 pricing will have to include technologies with significantly higher capital costs than even large coal-fired capacity of recent time. The obvious examples included fossil fuel capacity plus CO_2 capture and storage where a penalty is paid both in terms of much lower overall fuel efficiencies and much higher capital costs. But higher capital costs will also apply to technologies such as photovoltaics and solar thermal.

Thus, energy costs are likely to increase at a significantly greater rate in the future, driven especially by constraints on CO_2 emissions. Actual prices of electricity to the consumer will increase even more rapidly since these costs will increasingly include the charge applied to the CO_2 emissions themselves.

Georgescu-Roegen's comments, made thirty years ago, (1979: 1055)—subject to revision about technological progress in the interim, but without reference to 'dangerous' climate change—may be pertinent:

> Undoubtedly, the sun is the only steady and completely healthy source of energy whether for a new "Wood Age" or some other kind of solar age. At present … it seems very unlikely however that it will enable mankind to fly in jets, to live in sky-scrapers, and to travel in automobiles at one hundred kilometers per hour, for example.
>
> To try persistently to find more efficient recipes is not only legitimate, it is imperative. But to claim that solar technology is here before it actually is, or to preach that "come what may we shall find a way" will only conceal from public awareness the seriousness of the acute problem of natural resources and thus render any move toward an adequate policy to deal with that problem far more difficult than it actually is.

In the same context (1979: 1053) Georgescu-Roegen also noted that

> At present it is not possible to produce collectors only by the solar energy that they collect. Any use of presently feasible recipe based on solar collectors, therefore is a parasite of the current technology. And like any parasite could not survive its host.

Less radically stated, the point is that the cost of electricity produced by such means will be substantially higher than currently. Hence the CO_2 savings will not just be as a result of switching to less CO_2-intensive supply-side sources but to the increasing cost and hence price of electricity consumed. This will prompt not only improvements end-use energy efficiency but also substantial reductions in net electricity consumed that will reflect both reduced consumption of energy services and induced improvements in the energy efficiency of both electricity generation and electricity consumption.

For example, the Paris-based International Energy Agency (IEA) has assumed that the additional investment cost of energy-saving technologies in an 'Alternative' greener global energy sector scenario will be comparable to the investment costs of avoided additional energy supply that would have been part of a 'business-as-usual' scenario for the same period to 2030 (IEA 2004: 368; IEA 2005: 252; IEA 2006: 161).

In 2006, the IEA published the results of such a well-documented technologically-detailed modelling exercise to determine the most cost-effective (that is, least costly) way to radically reduce CO_2 emissions from the energy sector by 2050. That modelling exercise made optimistic assumptions about the prospects for CO_2 capture and storage (CCS) and allowed nuclear power to remain at least at present levels. Nonetheless, it still found that end-use energy-saving would be the single largest source of cost-effective emission reduction at 44 per cent of the total[16].

Even casual observation casts doubt on the contemporary relevance of the Jevons paradox. Is it plausible that introducing diesel or gasoline-battery hybrid cars (such as the Prius) with up to twice the fuel efficiency of standard vehicles and five times that of Hummers will have double the existing average annual vehicle-kilometers? Or that more costly compact fluorescent light-bulbs—used in appropriate high utilisation applications— will not save significant electricity compared with standard incandescent bulbs they replace? However, the same two examples also indicate some the complexities.

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[16] The OECD/IEA analysed cost-effectiveness of technologies that could together reduce global greenhouse gas emissions as at 2050 by 60 per cent. Not all these scenarios included nuclear. In the case where new nuclear was permitted, it was found to account for only 6 per cent of the total emission abatement compared with 44 per cent from improved end-use energy efficiency, with the remaining 50 per cent from a variety of other technologies. http://2050.nies.go.jp/200606workshop/presentations/6-3Taylor.pdf. In the associated press release IEA Executive Director Mr. Claude Mandil stated:

> Accelerating energy efficiency improvements alone can reduce the world's energy demand in 2050 by an amount equivalent to almost half of today's global energy consumption. To achieve this, however, "governments, in both OECD and non-OECD countries, must be willing to implement measures that encourage the investment in energy-efficient technologies". http://www.iea.org/Textbase/press/pressdetail.asp?PRESS_REL_ID=180

First, though the CFLBs have capacity to save considerable energy this can be negated by badly designed legislation[17]. Second, more energy-efficient vehicles, by themselves could conceivably over the long-term encourage even more dispersed patterns of urban land settlement. However, three considerations negate such outcomes: (i) supportive legislation needs to based on sound analysis of market failure; (ii) higher resource costs and environmental charges associated with energy inputs will both encourage energy efficiency and negate rebound effects (iii) other rising costs will tend to suppress rebound effects, for example, time costs associated with intra-urban journeys.

Nor will such energy-efficient technologies (generally costing more in the first instance than standard technologies but saving energy expenses in the long-run) will have an economy-wide effect of boosting incomes and hence energy consumption.

In the case of crude oil we now seem to be facing the kind of natural limits (relative to demand growth) that Jevons pointed to for coal. These same limits are responsible (in part, and indirectly) for today's high oil prices.

The 'Jevons paradox' can be viewed as a relic of little relevance to the resource-constrained 21st century. All this is as Jevons himself would have predicted on the basis of his views on resource limits, and despite his awareness of technological 'progress' and international trade, neither of which will completely offset the higher costs implied in more energy-efficient technologies.

[17] The *Energy Independence and Security Act* of 2007 passed the US Senate on June 27, 2007. http://www.sourcewatch.org/index.php?title=CLEAN_Energy_Act_of_2007 This US Legislation has enacted a ban by 2012 on the standard incandescent bulbs that make economic sense in low utilisation applications. It is not unlikely that utilisation rates will increase in these cases resulting in some rebound effect. This could be viewed as exemplifying imperfect, if simple, policy.

Appendix 2. Extract from 2005 Interview with Professor Kenneth Arrow

http://mpra.ub.uni-muenchen.de/967/1/MPRA_paper_967.pdf

JD: Health care throughout the world is in trouble. Do you think that that's the case because policymakers do not understand the problems that you pointed out in your 1963 AER paper, or because there are other "political" issues that can't be resolved?

KA: Well, health-care throughout the world is in trouble, that's right. That is because there's something intrinsic in the nature of health care. Let me explain what I mean. There are three elements which happen to be interactive in a way which makes health care intrinsically a problem.

In the first place, it's a highly risky situation: one person will have a 150,000 dollar operation, the other will not. It's just chance. In a way, it's an ideal situation for insurance. This is exactly the situation insurance is designed to cover.

Then, on the other hand, insurance is difficult to arrange, because of the asymmetric information aspects, the adverse selection and the moral hazard, without going through how you solve it, it creates difficulties.

But then there's a third aspect, our feeling that everybody should have decent health benefits. It is our social judgment that health is different from other commodities. If something is medically available, there is a presumption against denying it because of lack of income. I think that's the thing that distinguishes health from other goods. Education is somewhat comparable in that respect. Education, at least in the US is quite a problem. We do feel that people should have access to education, irrespective of their income. Some people may say "well, why not make education proportionate to income?" Well, we don't feel it is right. But let me stick to health, because that's the one we're talking about; the issues are similar, but not quite the same. Supposing there were no problems about insurance, supposing we could create an insurance policy which didn't suffer from adverse selection and moral hazard. Just imagine. Well, why not let the market prevail. The market will include a market for health insurance so at a given income level, the risks will be spread, in the usual way. Remove the uncertainty of cost. But that means that people who are poor will have to buy a very minimal kind of insurance and if they have an expensive operation it won't be covered. Obviously if a person can pay one tenth of a premium than another then that person is going to also get one tenth of the medical care. Well, we're not prepared to tolerate that. And here, by "we", I mean human beings, in any country, really. Certainly in any developed country. I am saying this just as a matter of fact, not as a moral judgment as to how things should be. There are attempts to regulate whether, let's say, motor cyclists should wear helmets. The same happens with other safety regulations and safety requirements, like seat belts. Well, what's the argument there? I suppose we can say "the guy doesn't wear a helmet, he gets killed, that's his problem." Or if he gets injured, that's too bad, that doesn't affect us. And the answer usually is not that one. Society is going to do something for him, or her. If a person is injured, we're going to take care of him, so we have a right to prevent him from being damaged. The same thing happens with tobacco. We tax tobacco so it becomes prohibitive, we tax it very heavily. Well, why not, let a person smoke himself to death? What does it matter? We're assuming people are well-informed so, why not let them? Well, part of the reason is, if they get lung cancer, we're going to pay for it. We pay for those operations. Therefore, we have the right to protect ourselves against that individual's bad habits. Also, we're not prepared to let people suffer for lack of medical attention. No matter what their income is. And we therefore take steps. And in this case we take steps by saying we're going to have some kind of redistribution within the system. Some go to the extreme of the single payer system; some like Canada even prohibit private practice. In others like England, you have a system for everybody and then you can buy private practice. I don't know what Uruguay does.

In the US, the fact is that before there was any medical insurance, there was always charity. A county would have a hospital, for people who couldn't afford otherwise. And also every doctor was expected to give time free of charge. Medical insurance to some extent relieved the doctors of their obligation for free work. They don't feel that obligation today. And the argument is that if you need open-heart surgery your property should not be a barrier. Once you have that, you can't really have a market system. Now, on top of that, there's the fact that technological progress means there's all sorts of treatments available now. Nowadays there are drugs, surgical procedures, and so forth, which didn't exist before, and that keep on running up the costs. You might say "there's nothing really wrong with a society devoting 15% of its resources to healthcare. Healthcare is a perfectly good thing to spend your money on. Why not? I don't see that healthcare is inferior to more expensive houses or things like that." But, the problem comes that since we no longer provide through the market, we have to have a tax structure, and of course, any tax structure creates inefficiencies. And that's even if the system is at its best. And, when you start with insurance you have moral hazard issues, and now the unnecessary medical expenditures occur. But I think it's intrinsic in the nature of the situation. You can reduce the burden but you can't eliminate the problem.