

# Fostering the Development of Renewable Energy through Green Taxes and Other Instruments

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An earlier version of this article was presented as a paper at the 17th Australasian Tax Teachers' Association Conference hosted by Victoria University of Wellington on 26-28 January 2005 in Wellington, New Zealand.

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## 1. INTRODUCTION

The generation of renewable energy derives from replenishable sources such as sunlight or solar energy, wind, waves, biomass and hydroenergy. The major technical challenges that have held up attempts to harness renewable energy on a commercial scale relate to collection and storage. In spite of these challenges, the drive to increase the generation of renewable energy capacity has been underscored by two major developments: first, concerns about the effects of greenhouse gas emissions and their impact on climate change, and second, concerns about the energy security issues stemming from the unsustainable levels of consumption of non-renewable resources.<sup>1</sup>

Governments around the world have used economic instruments, such as green taxes and fiscal incentives, as well as market instruments and a range of direct regulatory measures to address these concerns. Economic instruments, if properly applied, can be a useful tool in curbing pollution. They lead to internalizing external costs in prices and can encourage technological innovation.

This article critically evaluates the challenges of using green taxes to foster the development of renewable energy and examines some of the ways of dealing with these challenges. The article also examines the interaction of taxes and other regulatory measures with a view to assessing

their complementary roles in developing alternative sources of energy.

The primary focus of the analysis is on Australia's experience, but lessons will be drawn from the experience of other OECD countries for comparative purposes.

## 2. THE CHALLENGES POSED

The main challenges to the use of renewable energy have been articulated as follows:

Renewable energy [technologies] can increase diversity of energy supplies and replace diminishing fossil fuel resources over the long run. They can also make use of indigenous resources to provide cost-effective and secure supply options. They ... could substantially reduce greenhouse gases and other pollutants if substituted for fossil fuels. But though their costs are falling, many technologies based on renewable energy are still at an early stage of development, and technical barriers remain.<sup>2</sup>

In Australia as in other countries, the drive to increase renewable energy capacity for electricity generation (stationary energy)<sup>3</sup> and transport use (mobile energy)<sup>4</sup> has been sustained by varying levels of support from the government, industry and community sectors.

Stationary energy sources have changed considerably over time given the relative readiness of the availability of substitutes. For instance, while coal, wood and oil were once major sources of energy for heating, they have now been largely replaced by gas and electricity. Internationally and in Australia, fuels generated from these sources have generally been subject to low or no fuel taxes. This is largely attributable to the fact that, until recently, the provision of gas and electricity was under the control of state-owned utilities.

Unlike stationary energy, the different forms of mobile energy provide steady streams of revenue to governments owing to the high taxes levied on mobile energy. Two fea-

1. For the dimensions of the challenges posed by energy security, see OECD and International Energy Agency, *World Energy Outlook: Assessing Today's Supplies to Fuel Tomorrow's Growth, 2001 Insights* (Paris, 2001); United Nations Development Programme, UN Department of Economic and Social Affairs, and World Energy Council, *World Energy Assessment: Energy and the Challenge of Sustainability* (2000), Chap. 4; and van Orman, C.L., "The National Energy Strategy – An Illusive Quest for Energy Security", 13 *Energy Law Journal* 251 (1992).

2. OECD, *Sustainable Development: Critical Issues* (Paris: OECD, 2001), at 355.

3. Stationary energy needs (such as heating, cooking and lighting) rely predominantly on gas and electricity.

4. Mobile energy needs rely primarily on liquid petroleum products (such as petrol and diesel) to supply energy for mobility.

tures of mobile energy sources are responsible for their exposure to high taxes: first, their widespread use as a transport fuel, and second, the lack of readily accessible and cost-effective substitutes. Ironically, however, these very attributes have also contributed to the legacy of environmental degradation and the security (of supply) crises that have been associated with energy use. To add another twist to the irony, these two features present the greatest technological hurdle to the development of substitute petroleum products.

In examining the potential challenges of using economic instruments to increase the generation of renewable energy capacity, the central focus of this article is on the impact of such instruments on the development of alternative sources of mobile (rather than stationary) energy sources.

There is widespread concern internationally that human activities contribute to the increasing incidence of global concentrations of carbon dioxide and other greenhouse gases in the atmosphere.<sup>5</sup> In its report, the IPCC observed that "... [t]here is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities".<sup>6</sup> The human activities in question relate primarily to the combustion of fossil fuels for energy and the clearing of vegetation. The concern is that the heat-trapping gases generated by the production and use of energy contribute to global warming, and these in turn could trigger future climatic changes. While there is scientific consensus that action is needed, there is less agreement on the measures to be taken. The commitments made at the Kyoto summit in December 1997 limit the growth of emissions in Australia to 108% of the 1990 levels over the period 2008 to 2012.<sup>7</sup> While the federal government has indicated that it is on track to meet its Kyoto commitments, their significance is diminished in light of the indication by the Commonwealth Scientific and Industrial Research Organisation that a 60% to 85% reduction in greenhouse gas emissions around the world is required if atmospheric carbon dioxide is to be stabilized at pre-industrialized levels.<sup>8</sup> Further, the Electricity Supply Association of Australia has painted a pessimistic prognosis by indicating that emissions from electricity generation, which account for one third of Australia's greenhouse gas emissions, are expected to increase by 60% from 1990 to 2010.<sup>9</sup> Although Australia produces about 1.6% of the world's greenhouse gas emissions on a national basis, it is one of the highest emitters of greenhouse gases in the world on a per capita basis.<sup>10</sup> There are large global inequalities in the contributions to climate change, with 20% of the world's population in industrialized countries accounting for about 75% of global greenhouse gas emissions. Australia has consistently refused to ratify the Kyoto Protocol even though Australia signed it in 1997, taking the view that, unless major emitters sign, the Protocol would deliver only about a 1% reduction in greenhouse gas emissions worldwide.

Another reason for developing substitute petroleum products relates to concerns about the future viability of the current oil reserves based on the increasing levels of unsustainable consumption of this non-renewable resource. Various factors are at the heart of these concerns.

First, at a time when economic growth across the world is increasing rapidly, fossil fuel production has either been stagnant or in decline. No new major fields on the scale of Saudi Arabia's fields have been discovered over the past 40 years in spite of improvements in prospecting technologies. The concern here is that the existing reserves are projected to peak or decline in the absence of major discoveries.<sup>11</sup> Second, most of the major oil-producing regions have been plagued by political instability and security crises (e.g. the Middle East, Nigeria, Russia and Venezuela). The pressures on the existing reserves have been accentuated by the emergence of countries such as China and India, which are using increasing amounts of imported energy to fuel their huge and expanding economies. To illustrate one dimension of the challenge posed by this development, it was estimated that, in the first five months of 2004, China added an average of 14,195 vehicles to the road each day.<sup>12</sup> These considerations (among others) have led experts in the oil industry to speculate that oil supplies could peak in the next five to 15 years.<sup>13</sup> These factors in the aggregate are placing tremendous pressure on exploiting the reserves in fragile environments, such as the Arctic National Wildlife Refuge.

### 3. ADAPTING TAX INSTRUMENTS TO THE PRESSURES FOR CHANGE

Most modern tax systems were born out of the need to finance war. Before World War I, the main source of revenue for the Australian (federal) government consisted of customs and excise duties. All this changed when the war started as the government was forced to intervene in the income tax area (which was then under the control of the states) in order to raise additional revenue for the war. At the end of the war, the states and federal government exercised concurrent jurisdiction in imposing income taxes. In 1942, however, the federal government ousted the states from the income tax arena and introduced the "Uniform Taxation Scheme", which still operates today. The federal government now re-allocates the revenue raised from the income tax to the state and territory governments under a special formula for allocating grants.

5. The main greenhouse gases are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

6. Intergovernmental Panel on Climate Change (IPCC), *Third Assessment Report: Climate Change 2001: The Scientific Basis* (2001), at ix (Preface).

7. Watson, R.T., "1999 Report to the Fifth Conference of the Parties of the United Nations Framework Convention on Climate Change (Chairman's Report), IPCC"; available at [www.ipcc.ch/press/speech11-99.htm](http://www.ipcc.ch/press/speech11-99.htm); see also Australian Greenhouse Office, "National Greenhouse Gas Inventory 2000" (Canberra), at [www.greenhouse.gov.au/international/kyoto/index.html](http://www.greenhouse.gov.au/international/kyoto/index.html).

8. Greenpeace Australia Pacific, "Putting Renewables on Target: A 10% Mandatory Renewable Energy Target"; available at [www.greenpeace.org.au/climate/solutions/powershift.html](http://www.greenpeace.org.au/climate/solutions/powershift.html).

9. *Id.*

10. Commonwealth of Australia, *Securing Australia's Energy Future* (2004), at 133.

11. Roberts, Paul, *The End of Oil: On the Edge of a Perilous New World* (New York: Houghton-Mifflin, 2004), at 44-64.

12. Wonacott, Peter, "Choking Demand", *Australian Financial Review*, 14 July 2004, at 60.

13. Roberts, *supra* note 11, at 58-65.

Fuel taxes have been used predominantly to raise revenue and have thus played an increasingly important role in the overall tax mix. A survey of 21 OECD countries revealed that the revenue from fuel taxes accounted for 7% of the total tax revenue. Of this figure, the tax on mobility services accounted for the greatest share in the OECD as a whole, with petrol and diesel providing 59% and 30%, respectively, of the fuel used for road transport; liquefied petroleum gas contributed 1% (except in Australia, where it accounted for 8%).<sup>14</sup>

The revenue from fuel taxes (or the taxes on petroleum products) in Australia amounted to AUD 12.2 billion in 2001-02, accounting for 7.7% of the total tax revenue.<sup>15</sup> In the same period, expenditure on rebates and subsidies for fuels amounted to AUD 2.9 billion.<sup>16</sup> The net revenue to the government therefore was AUD 9.3 billion. Petroleum fuels are the only fuels that attract tax in Australia. Within this group, the highest tax rate (around 38 cents per litre) applies to fuels used predominantly in transport (petrol and diesel).

Global policy developments in fuel taxation reflect a discernible pattern showing that tax policy has adapted to tackle the ever-changing challenges presented by the development and use of energy. Before the second half of the 20th century, the traditional policy focus of fuel taxation was on raising revenue, but afterwards the policy focus was on addressing the needs of economic development. Thus, taxes were levied on petroleum products used in transport for general revenue-raising (at least before World War I) and for funding the costs of road infrastructure. In response to the shock of crude oil prices in the mid to late 1970s, the focus shifted to energy security or fuel diversity. To foster the development of substitute petroleum products, low or zero fuel tax rates applied to these substitutes.

The policy focus changed again in the 1980s, when governments became (increased)ly aware of the effects of fuel use on the environment and human health. Tax expenditure measures, such as low or zero tax rates, were again invoked to reduce the cost of substitute petroleum products in a bid to change consumer behaviour. Towards the end of the 1990s, the dynamics of change were driven by governments' concerns about the effects of change in regional and rural communities, especially in the primary production sector. To address this, governments again imposed low or zero tax rates on substitute petroleum products developed from agricultural products (e.g. ethanol and other forms of biomass) in order to provide the measures required for regional development and industry assistance to communities in distress.

Despite the deliberate use of fuel tax policy since the mid-1970s to increase the generation of renewable energy capacity, petroleum products continue to be the dominant source of energy for mobile energy needs. This is due primarily to the availability of few economic substitutes for petroleum products in internal-combustion engines and to the fact that they provide reliable and high quality energy in a relatively cheap, easily distributed and compact form.

#### 4. CURRENT CONTRIBUTION OF RENEWABLES TO THE ENERGY MIX

A 1995 study by the Stockholm Environmental Institute predicted that fossil fuels will continue to dominate the world energy supply until 2050 and that the contributions from renewable and nuclear energy will also expand significantly.<sup>17</sup> Renewable energy currently makes up 10.5% of Australia's electricity supply. Around 90% of this comes from hydroelectric power stations constructed between the 1950s and the 1980s.<sup>18</sup>

The government has used a range of initiatives, such as direct grants, generous tax concessions and mandatory standards, to encourage the use of renewable energy in Australia. One of the most significant measures for fostering the development of renewable energy is the Mandatory Renewable Energy Target (MRET). This measure was announced by the federal government in the lead-up to the Kyoto Protocol negotiations in its "Safeguarding the Future" package.<sup>19</sup> Under the MRET, a mandatory target was set for electricity suppliers to satisfy an additional 2% of Australia's energy requirements from renewable sources by 2010. Apart from creating additional renewable energy capacity, the measure is designed to reduce greenhouse gas emissions and provide a larger base for developing commercially competitive renewable energy (Prime Minister's Statement). This measure was given legislative force through its enactment as the Renewable Energy (Electricity) Act 2000. It is policed through the use of "renewable energy certificates" which track the generation and purchase of renewable energy. While this measure was a world first and had the potential of increasing the amount of renewable energy in the energy mix, the 2% threshold was criticized as being relatively low compared with the targets in other jurisdictions. For instance, Germany is among the world leaders with a 12% renewable target by 2010; the United Kingdom has a renewable target of 10% by 2010, which it hopes to increase to 20% by 2020; and India has flagged a 12% target by 2012. Proposals to increase Australia's target by an extra 10% were rejected by the federal government in its *Energy White Paper* (Greenpeace prepared a paper canvassing the benefits of a 10% MRET).<sup>20</sup>

The regulations under the Renewable Energy (Electricity) Act 2000 adopt a broad definition of renewable energy. The definition includes production increases from hydro-

14. OECD, *Environmentally Related Taxes Database* (Paris, 2001), at 6; available at [www.oecd.org/env/tax-database](http://www.oecd.org/env/tax-database).

15. Government of the Commonwealth of Australia Budget 2001-02, *Budget Paper Number 1 – Budget Strategy and Outlook*, Statement 5, Appendix E, Table E1.

16. Australian Parliamentary Report, Fuel Taxation Inquiry, *Issues Paper*, 18 August 2001, at 26.

17. Stockholm Environmental Institute, *Global Energy in the 21st Century: Patterns, Projections and Problems* (Stockholm, 1995).

18. "Putting Renewables on Target: A 10% Mandatory Renewable Energy Target", supra note 8.

19. The Hon John Howard, "Statement by The Prime Minister of Australia", The Hon John Howard MP, "Safeguarding the Future: Australia's Response to Climate Change", Office of the Prime Minister and Cabinet (1997); available at [www.pm.gov.au/news/media\\_releases/1997/GREEN.html](http://www.pm.gov.au/news/media_releases/1997/GREEN.html).

20. "Putting Renewables on Target: A 10% Mandatory Renewable Energy Target", supra note 8.

electric generation, power generated from the combustion of native forest wood waste, and incineration of municipal waste. The inclusion of these sources distorts the baseline of the MRET, as the technologies involved are far from sustainable.<sup>21</sup>

The state, territory and local governments have also been actively involved in promoting the development of alternative energy sources and assisting industries in commercializing and using sustainable energy technologies. For example, under the Electricity Supply Act 1995 (NSW), New South Wales imposes mandatory reduction targets on its privatized electricity industry. In addition, the Victorian government announced a plan of action in 2000 to combat greenhouse gas emissions.

## 5. GREEN TAXES AND ENVIRONMENTAL POLICY

A wide range of nomenclature is used interchangeably in the literature to describe green taxes, including eco-taxes, environmental taxes and ecological taxes. The OECD, in cooperation with the International Energy Agency (IEA), EUROSTAT and the European Commission, has formulated the notion of “environmentally related taxes” to encapsulate the range of different labels used to describe these fiscal measures. The term implies that the name or the express purpose of a given tax is not a criterion for determining whether or not a tax is relevant to the environment since the use of labels can be misleading. Instead, the term focuses on the economic rationale and effectiveness of the tax. Consequently, the potential environmental effect of a given tax is determined by its impact on the producer and consumer prices in question, in conjunction with the relevant price elasticities.<sup>22</sup> For instance, even if the existing fuel taxes are not expressly designated as “environmental”, they still have the same impact on the environment regardless of whether their express purpose is to raise revenue or to combat climate change. The literature also draws a distinction between taxes and charges, the latter being payments for specific services, such as the treatment of sewage or waste collection. The OECD, in cooperation with the IEA, the European Commission and the European Environment Agency, has compiled a comprehensive database of environmentally related taxes and charges.<sup>23</sup>

A cardinal principle of environmental policy that is integral to green taxes is the “polluter pays principle”. This principle requires that the external environmental costs of economic activities be, as far as possible, reflected in the prices of the goods/services concerned and borne by those who produce them and by taxpayers or the public at large. Under this principle, the expectation is that these costs are reflected as price signals in production and consumption decisions, but the principle does not require that environmental costs be imposed on the polluter.

Pollution is a negative externality – an economic activity that pollutes or hampers the well-being of individuals who are affected by it but receive no compensation in return. In market economies, environmental degradation is essentially caused by market failures, i.e. when prices do not

adequately reflect the environmental costs. The OECD and the EU Commission both consider that environmental taxes have the potential of reducing the costs of pollution below the limits normally associated with normal regulatory practice. They may offer cheaper alternatives than “command and control” measures to solve the same problems. In the context of the Kyoto commitments, for instance, not using tax instruments now may mean stronger alternative action in the future.

Environmental externalities can be internalized into a pricing regime through the introduction of differential taxes. In its bid to address air quality issues, for instance, Australia introduced a fuel excise differential of 1 cent per litre in 1994 (later rising to 2.4 cents per litre) to increase the cost of leaded petrol relative to unleaded petrol. This was designed to encourage motorists whose vehicles could use either type of fuel to use unleaded fuel, or to convert their vehicles so as to make them compatible with unleaded fuel, and thus hasten the transition to vehicles using unleaded fuel only. The use of leaded petrol was eventually phased out on 1 January 2002, when legislation banning its production and sale became effective. Sulphur is present in all crude oils. Reducing the sulphur content in fuels therefore cuts the harmful emissions and particulates discharged into the atmosphere from vehicles. To achieve this, the federal government, in its initiatives in “Measures for a Better Environment”,<sup>24</sup> foreshadowed reducing the sulphur content of diesel fuel through an excise differential of 1 cent per litre from 1 January 2003, rising to 2 cents per litre for 2004-05, and then mandating ultra low sulphur diesel as from 1 January 2006.<sup>25</sup>

When green taxes are designed to change the relative prices of fuels, their effectiveness in inducing consumers to switch to the most cost-effective “cost mix” depends on two major variables. First, there must be few technological limits on fuel substitution. Second, while important gains can be achieved with low levels of taxation, the need for moderation in such cases is underscored by the fact that sharp increases in fuel prices could have the opposite effect, generating strong inflationary pressures. These variables highlight the practical realities that impose limits on fully internalizing the external environmental costs into a pricing regime. In practice, non-tax measures (direct regulation) have been used as invaluable complementary instruments to accelerate the change in consumer behaviour. The use of direct regulation in this manner has changed previously accepted relationships between fuel

21. Bradbrook, A.J. and A.S. Wawryk, “Government Initiatives for Promoting Renewable Energy for Electricity Generation in Australia”, 25 *UNSW Law Journal*, No. 1 (2002), at 124, 149-151, 156 and 158.

22. For some of the issues in the debate on the nature of environmental taxes, see Barde, Jean-Philippe, “Implementing Green Tax Reforms in OECD Countries: Progress and Barriers”, and Soares, C., “Environmental Tax: The Weakening of a Powerful Theoretical Concept”, both in Ashiabor, H., K. Deketelaere, L. Kreiser and J. Milne (eds.), *Critical Issues in Environmental Taxation: International and Comparative Perspectives* (United Kingdom: Richmond Law and Tax Ltd, 2005), Vol. II at 3 and 23, respectively.

23. *Environmentally Related Taxes Database*, supra note 14.

24. “Measures for a Better Environment” is a package of environmental measures announced by the Prime Minister in May 1999 as part of A New Tax System; available at [www.deh.gov.au/atmosphere/airquality/measures.html](http://www.deh.gov.au/atmosphere/airquality/measures.html).

25. The Fuel Quality Standards Act 2000 mandates new Australian standards for diesel with low sulphur content.

use and its cost. Government-imposed standards have improved the quality of fuels. In Australia, the lead content of fuels was abolished (through mandatory standards) and, as mentioned above, the sulphur content is being reduced (with ultra low sulphur diesel being mandated from 2006).

The taxation of fuels has not stemmed the growth in the use of motor fuels. The growth is due to the increase both in absolute car numbers and in usage over the period. The demand for transportation reflects the desire of individuals for even more convenient and rapid access to goods and services. For most individuals, private transportation is the preferred form of transport. Total demand for transport is therefore relatively insensitive to the price of fuel in the short term because the demand for private transportation is closely related to levels of income. In Europe, for instance, the number of motor vehicles is growing despite higher vehicle taxes and post-tax fuel prices. This increasing demand is more a function of rising incomes in Europe. Further, public attitudes to vehicle ownership are ambivalent – “my car is indispensable, but your car causes congestion”. The ineffectiveness of measures in this area has not been helped by the fact that government policy on car ownership has been inconsistent – committed to reducing the impact of cars in general but, for reasons of the public’s reaction, hesitant to impose any drastic measures to realize the government’s objective.

The use of fossil fuels generates various external costs which are often not reflected in the pricing of petroleum products. A central obstacle to integrating externalities into a fuel pricing regime is that, if the relationship of the external costs to fuel use is indirect, the external costs do not lend themselves to precise measurement. Fuel taxes in such cases would be an inappropriate instrument for internalizing these costs for a variety of reasons. Road accidents, for instance, are directly attributable to driver competence, vehicle maintenance and/or road conditions and have only an indirect link to fuel use. The same applies to the noise effect of vehicle use. Its relationship to fuel use is indirect as it varies with location and type of application (a new vehicle as opposed to a poorly maintained old vehicle) rather than with fuel use as such.

Road maintenance costs are another external cost that is related to fuel use. The difficulty that becomes immediately apparent here is that the amount of fuel used is only one of the causal factors relating to road maintenance costs. These costs also depend on other factors, such as the type of road and the type of vehicle (since road damage increases exponentially with the mass configuration of vehicles). In the state of New South Wales, this was partially addressed by imposing the “3 x 3” fuel levy, introduced in 1989 as a surcharge of 3 cents per litre on petroleum licence fees.<sup>26</sup> The revenue was earmarked to fund road improvements and road safety. Although the legislation introducing this levy had a sunset clause, making it lapse at the end of three years, it continued until August 1997, when the levy was declared unconstitutional.<sup>27</sup>

External costs, such as those for road maintenance, are now effectively internalized through variable electronic

road pricing systems. Most European countries, including Germany, the Netherlands and Switzerland, have replaced their fixed road charges with a vehicle tracking system to implement a variable road pricing system. Under the latter, the charges imposed on motorists vary with the distance travelled, vehicle mass and vehicle emissions standards. In Australia, the electronic tolling systems in operation (in Brisbane, Melbourne and Sydney) charge according to vehicle type and the section of road used.

The indirect and direct external costs of fuel use discussed here raise the question of whether it is possible to devise tax arrangements that effectively internalize the external costs that were highlighted. As mentioned above, taxes are not the most appropriate instruments for internalizing the indirect costs. As to air quality issues and road maintenance costs, improvements in technology rather than the use of green taxes have been more effective in dealing with the external costs. Therefore, even if the external costs can be determined, imposing a fuel tax on all users might not be the best way to internalize them. Fuel taxes tend to be poorly targeted and inefficient, and they can be counterproductive.

The restructuring of existing taxes is another way in which green taxes have been used to ensure that appropriate price signals are sent to polluters regarding the impact of their production and consumption decisions on the environment. The energy and transport sectors are some of the possible areas where such restructuring could reflect the polluting characteristics of the different products or activities. In the particular case of energy taxes, the restructuring could be fashioned so as to benefit the environment by increasing the relative prices of the most polluting products. This form of restructuring is essential as energy/fossil fuel-based products are a main source of both pollution and tax revenue. Since taxes on motor vehicle fuels account for over 50% of the pump price in most OECD countries, this provides considerable scope for restructuring fuel taxes on the basis of environmental parameters, as the Nordic countries, Germany, Ireland and the United Kingdom have done. Australia has applied similar measures, albeit to a much lesser extent than these countries, through the use of differential taxes and mandatory fuel standards, as discussed above regarding the phasing out of leaded petrol and sulphur in diesel.

The existing taxes could be also restructured to internalize an externality such as air pollution by the introduction of taxes based on the carbon content of the energy source used. Such a measure can cause a change in the fuel mix as the tax can be used to correct market failures or internalize externalities. In the case of air pollution, for instance, the introduction of a tax on carbon content can cause a shift in the fuel mix from carbon-intensive fuels to greener fuels derived from natural gas, biomass, etc.

26. The levy introduced in 1989 was supposed to last three years but it survived until 1997, when it was absorbed into the total fuel excise. For further comment on the levy, see *Commonwealth of Australia, Parliamentary Debates, House of Representatives*, 23 June 2003, at 16,197 (Michael Hatton, MP).

27. *Ha & anor v. State of New South Wales & ors and Walter Hammond & Associates Pty Ltd v. State of New South Wales & ors*, 97 ATC 4674; (1997) 189 CLR 465.

Unilateral measures designed to restructure the consumption of energy in the transport, industry and domestic sectors should be implemented with caution because, if the measures are not replicated in competing countries, issues of competitiveness may arise. The EU energy tax proposals tabled on 17 March 1997 envisaged an increased threshold in the European Union for the existing excise on all forms of mobile energy, and the proposals recommended the introduction of new taxes on stationary sources of energy such as coal, electricity and gas. To date, the EU Member States have not been able to agree on the scope of future energy taxes, the rates to apply, or the sectors (if any) to be relieved. One reason for the stalled negotiations is that there appears to be no indication from comparable jurisdictions, such as the United States which is a significant consumer of energy, that they will introduce an energy tax similar to that proposed for the European Union. Any attempt to unilaterally restructure the energy tax regime in the EU could have far-reaching implications for the relative competitiveness of industry in the region.

## 6. TAX EXPENDITURES

The oil shocks of the 1970s marked a watershed in the role of tax policy in the energy sector. This was reflected in the change in the reason for levying energy taxes. Before the 1970s, they were used exclusively as a general revenue-raising instrument. Afterwards, energy taxes were used to address fuel security issues, but later they also addressed environmental protection and the general concerns regarding "industry support". The principal instrument for pursuing these objectives has been tax expenditures such as incentives, tax subsidies, tax credits and government grants.

Tax expenditures have been the instrument of choice because of the perception that they tend to have a much greater impact on consumer behaviour. Consumers perceive taxes as punishment, while a subsidy (such as an income tax credit) is seen as a reward. The effectiveness of subsidies as opposed to taxes as a tool for modifying consumer behaviour is also backed by empirical studies on energy conservation and clean fuel vehicles which revealed that subsidies applied to green power products tend to be more effective than environmental taxes on conventional power products in encouraging consumers to choose the renewable energy option.<sup>28</sup> The problem with subsidies is that governments need to fund them. Despite this, they are used extensively because they are more politically acceptable than taxes. In addition, subsidies can stimulate innovation by shifting decision-making to the private sector.

Tax expenditure measures, such as an excise-free regime, have been used to promote the demand or consumption of renewable energy with a view to reducing the price to consumers and to influencing consumers to choose green power. In the Netherlands, tax subsidies have been provided to consumers to encourage them to purchase green power. The subsidy exempts consumers purchasing a green power product from the eco-tax levied on electricity. This measure was instrumental in changing consumer

behaviour. The combination of tax credits and concessions at the production end and zero consumer rates has made the subsidy's impact on renewables much higher.

## 7. MEASURES TO ADDRESS ENERGY SECURITY

Various measures have been used to address the issue of energy security in Australia. These measures include generous tax deductions, excise exemptions, direct grants and indirect subsidies. To increase energy capacity through oil and gas exploration, for instance, the petroleum resource rent tax was designed to provide favourable tax rates to increase the incentives for petroleum exploration in frontier areas.<sup>29</sup> The tax was structured in such a way as to allow investors to earn a reasonable rate of return, and hence recoup some of their sunk costs, before they incur a tax liability. The tax allows a 150% deduction for pre-appraisal exploration costs in the frontier areas designated by the Minister for Industry Tourism and Resources.

Excise exemptions and direct grants have also been used to stimulate innovation to boost the production capacity of renewable energy sources by shifting the decision-making to the private sector. Sales of liquefied petroleum gas (LPG), for instance, enjoy a full excise exemption. These measures have fostered the development of the domestic LPG industry to the extent that it is now the main alternative to petrol and diesel for transport in Australia.<sup>30</sup> For example,

- LPG accounts for 8% of Australia's automotive fuels market;
- over 0.5 million vehicles that use LPG are dual-fuelled;
- over 1.25 million households and commercial premises use LPG;
- around 37% of Australia's production of LPG is exported; and
- there are 2,500 automotive LPG conversion/service and repair businesses and 65 automotive LPG component manufacturers and suppliers in Australia.

World supplies of LPG, which naturally occurs with natural gas, are expected to increase by 70% between 2000 and 2020.<sup>31</sup> The flaring of LPG is likely to be reduced, thus increasing the output from refineries. The increased supply will be matched by the pent-up demand for bottled LPG in countries such as China and India.

28. Bennett, P. and N. Moore, "Consumer Preferences for Alternative Energy Conservation Policies: A Trade-off Analysis", 8 *Journal of Consumer Research*, December 1981, at 321.

29. For purposes of the tax, the frontier areas are Australia's offshore area.

30. Similar incentives have encouraged the growth of the compressed natural gas (CNG) industry. Unlike LPG, however, CNG has a much smaller share of the market with approximately 2,200 vehicles using less than 0.5% of this auto fuel. This is due primarily to the absence of a widespread distribution network.

31. International Energy Agency, *World Energy Outlook: Insights 2001* (Paris, 2001), at 139.

## 8. BIOFUELS AND ETHANOL

Biofuels are another renewable fuel source whose production is heavily subsidized.<sup>32</sup> Biofuels are produced from a range of sources such as ethanol, bio-diesel (vegetable oil crops, waste meat products such as tallow, and recovered cooking oil) and methanol produced from biomass. Ethanol, a liquid alcohol, is usually produced from biomass crops rich in sugar, starch or woody (lignocellulosic) material. It is one of the major biofuels used in Australia as an automotive fuel. Although Australia has a local sugar and wheat industry, the production of ethanol is supplemented by imports from Brazil since the local industry is unable to produce enough raw materials to meet the production capacity. Before September 2002, ethanol production enjoyed an excise-free regime. In 2002, the government announced a biofuels initiative worth AUD 50 million to enable renewable fuels such as ethanol to provide 2% of the country's transport fuel.<sup>33</sup> Under this initiative, the government moved one step further by replacing the excise exemption for ethanol with a two-tier regime under which it is subject to an excise duty of approximately 38 cents per litre, which applies to petrol and diesel. This change was intended to equalize the tax treatment of fuels, thereby promoting tax neutrality. To realign the measures with their renewable energy objectives, the government in the same tax package provided a concurrent subsidy of 38 cent per litre to local ethanol producers. This effectively removed the excise on locally produced ethanol. The concession was not extended to imports. The lack of uniformity in the excise regime was intended to make imported ethanol much more expensive than it would otherwise be. This industry protection measure was designed to foster the development of the domestic ethanol industry. The effective excise rate of zero, implemented through a subsidy for local ethanol producers equal to the excise rate, will be phased out during the period 2008 to 2013 in order to provide parity of treatment with imported ethanol.

In spite of government support, ethanol still accounts for a very small proportion (about 0.03%) of the total fuel consumption in Australia. The widespread use of ethanol as an automotive fuel has been constrained by technical limitations. For example, because ethanol is 30% less fuel-efficient than petrol,<sup>34</sup> it cannot power a vehicle as far on an equivalent amount of petrol. Further, as an automotive fuel, ethanol is usually sold as a blend with petrol because vehicle manufacturers have said that blended fuels with more than 10% ethanol could cause corrosive engine damage and thus void warranties.

The government appears to be caught in a catch-22 situation regarding its industry support measures. On the one hand, the renewable energy sector has consistently maintained that the viability of its industries would be jeopardized if the existing tax concessions are reduced. On the other hand, if government subsidies in the form of excise exemptions continue, the revenue forgone is likely to be increasingly significant if production expands. It has been estimated that, if ethanol captured 10% of the market for petrol by 2010, the revenue loss would be about AUD 688 million per annum for ethanol alone.<sup>35</sup>

## 9. NON-TAX MEASURES

Fiscal instruments (in particular, grants, subsidies and levies) have also been used with the specific objective of altering market prices in the form of transfers to consumers via underpricing. To address the dual challenges of reducing greenhouse gas emissions and improving the quality of urban air, the Australian government launched "Measures for a Better Environment", a package comprising non-tax measures that targeted programmes outside the tax system.<sup>36</sup> The initiatives were designed to increase the utilization of green energy products by consumers. The use of non-tax measures (grants) to address greenhouse gas emissions is in line with the government's stance that it does not consider more taxes to be the answer to reducing Australia's greenhouse gas emissions.<sup>37</sup> The programmes include:

(a) The Energy Grants (Credit) Scheme. It became effective on 1 July 2003 and provides incentives for using clean fuels in line with the government's overall environmental objective to improve air quality.<sup>38</sup> Towards this end, businesses (especially in rural and regional Australia) are eligible for grants in respect of fuel used for certain designated activities in order to reduce their costs. The grants vary with the activity and are available only if certain eligible fuels are used.<sup>39</sup> For this purpose, the eligible fuels are diesel, natural gas products (LPG, compressed natural gas (CNG) and liquified natural gas (LNG)), ethanol and other biofuels.

(b) The Alternative Fuels Conversion Programme. This provides a range of incentives to encourage operators of heavy commercial vehicles and public transport buses to use CNG or LPG instead of diesel. These measures are backed by a CSIRO study which compared transport fuels in heavy vehicles and concluded that the use of LPG and

32. The parliamentary debates indicate that the excise treatment of LPG and ethanol was specifically designed to diversify Australia's liquid fuel sources with a view to insulating the economy from potential increases in the price of crude oil. See *House of Representatives Hansard*, 28 February 1980, at 507-508.

33. For the government's policy announcement on biofuels, see National Party of Australia, *Biofuels for Cleaner Transport*, Policy Statement; available at [www.nationalparty.org/policies/2001-10-31-biofuels.htm#twf](http://www.nationalparty.org/policies/2001-10-31-biofuels.htm#twf).

34. International Energy Agency, *Automotive Fuels for the Future: The Search for Alternatives* (Paris, 1999), at 51.

35. ABARE, *Viability of Sugar Cane-based Ethanol* (Canberra, 2001).

36. For "Measures for a Better Environment", see note 24, supra; AUD 321 million in grants was allocated over four years; available at [www.deh.gov.au/atmosphere/airquality/measures.html](http://www.deh.gov.au/atmosphere/airquality/measures.html).

37. Senator, the Hon Robert Hill, "Australia Balances Environment with Expanding Economy", Press Release of 8 August 2001; available at [www.ea.gov.au/minister/env/2001/mr08aug201.html](http://www.ea.gov.au/minister/env/2001/mr08aug201.html).

38. The fuel tax rebate system that preceded the Energy Grants (Credit) Scheme (The Diesel Fuel Rebate Scheme and the Alternative Fuels Grant Scheme) was partial and inconsistent since some intermediate uses of fuel were rebated if the fuels were used for certain applications.

The objectives of the new scheme are set out in the Diesel and Alternative Fuels Grants Scheme Act 1999: "The purpose of the Energy Grants (Credits) Scheme will be to provide active encouragement for the move to the use of cleaner fuels by measures additional to those under this Act, while at the same time maintaining entitlements that are equivalent to those under this Act and the Diesel Fuel Rebate Scheme, including for the use of alternative fuels."

39. The Australian Taxation Office administers the scheme. Further information is available at [www.ato.gov.au/nonprofit/content.asp?doc=/content/34967.htm](http://www.ato.gov.au/nonprofit/content.asp?doc=/content/34967.htm).

CNG in such vehicles results in better air quality than low sulphur diesel fuels.<sup>40</sup>

To encourage the use of gas technology in vehicles, grants have been allocated under the programme:<sup>41</sup>

- a subsidy of up to a 50% to meet the additional costs of purchasing new commercial vehicles over 3.5 tonnes that are fuelled by CNG or LPG (compared with their conventionally fuelled equivalent); and
- a subsidy of up to a 50% to cover the costs of converting existing conventionally fuelled heavy vehicles to CNG or LPG.

(c) The Product Stewardship Oil Scheme. This is designed to encourage the reuse of waste oils by making a payment to oil recyclers for the treatment of waste oil products. The scheme is funded by a levy of 5 cents per litre paid by manufacturers of virgin oil and lubricants. The proceeds of the levy are earmarked to fund the payments made to oil recyclers.

(d) Adoption of the international (Euro) vehicle emission standards.

## 10. EVALUATION – THE FISCAL CONCESSIONS FOR RENEWABLE FUELS

The foregoing analysis has demonstrated the extent to which the tax treatment of alternative fuels has been driven by the policy of promoting their use instead of petroleum-based fuels. The predominant instrument used to realize this objective has been subsidies. Their popularity is evidenced by the fact that they account for a considerable proportion of public expenditures.

It is difficult to ascertain precisely the full extent of energy subsidies worldwide as many of them remain undocumented or unidentified – particularly the subsidies implicit in environmental externalities. This notwithstanding, the OECD has conservatively estimated that a total of USD 331 billion is spent annually on fossil fuel and nuclear subsidies. Of this figure, the OECD countries account for approximately USD 71 billion.<sup>42</sup> In Australia, the total expenditure on fuels, rebates, subsidies and grants provided in 2001-02 amounted to approximately AUD 2.9 billion.<sup>43</sup>

Another study of direct energy subsidies in the EU from 1990 to 1995 revealed that they were not environmentally friendly – almost 53% of the total subsidies benefited the fossil fuel sector, while only 6% was devoted to developing renewable energy sources. As pointed out earlier, however, mandating renewable energy targets is likely to tip the scales towards an increase in capacity of renewables as part of the overall tax mix.

Since the energy sector accounts for more than its fair share of environmental externalities, providing subsidies reverses the cardinal principle of sustainable development – “the polluter pays” to “pay the polluter”.

Further, a cardinal principle governing the design of taxes is that economic choices (purchasing and investment decisions) should be left unaffected as far as possible. Tax incentives have the potential of modifying behaviour.

Such outcomes can adversely affect the efficient allocation of resources since economic choices are then driven by the structure of the tax system instead of economic considerations. For instance, the government recently conceded that an AUD 44 million sugar assistance scheme earmarked for diversifying the sugar industry into new products such as ethanol had been frittered away by farmers into mill maintenance. As an editorial comment pointed out: “... the government must stop holding out perverse incentives for cane growers to stumble along when in its present form the industry will never compete with an enormous industry in Brazil that employs cheap labour on enormous farms.”<sup>44</sup>

The structure of the fuel tax system does not ensure neutrality because substitute fuels are not uniformly taxed (excised). Petrol and diesel, for example, attract a levy of 38 cents per litre, while most substitutes are excise free. The excise differential makes petrol and diesel much more expensive than they would otherwise be. While it can be argued that this is the intended consequence of the exemption, it distorts fuel-use decisions. As a result, resources are invested in certain fuels because of their tax status rather than because of their intrinsic nature in terms of cost-effectiveness or environmental performance.

The differential tax rate for readily substitutable fuels reflects a deliberate government policy to encourage the allocation of resources to the production of particular types of fuel, but it creates administrative costs if the concessions are restricted to certain uses.<sup>45</sup>

## 11. RESTRUCTURING ENVIRONMENTALLY DETRIMENTAL SUBSIDIES

Various interconnected issues arise when considering subsidy reform in the energy sector. The complexities of disentangling these issues were articulated by David Roodman in his book *Natural Wealth of Nations* (London: Earthscan, 1991), at 31: “Few public policies are as unpopular in theory and popular in practice as subsidies.”

There are two aspects to reforming subsidies in the energy sector. The first relates to removing or adjusting perverse subsidies (e.g. exemptions or other concessions that have a detrimental effect on the environment) in order to internalize the external environmental costs associated with energy use. Subsidies in this category directly foster dependence on fuel. An example is Australia’s fringe benefits tax (FBT) legislation. The FBT is a tax imposed on employers who provide non-salary benefits to employ-

40. Anyon, P., T. Beer, J. Edwards, T. Grant, J. Lapszewicz, G. Morgan, P. Nelson, H. Watson and D. Williams, *Comparison of Transport Fuels: Life-Cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles* (Melbourne: CSIRO, 2001); available at [www.greenhouse.gov.au/transport/pdfs/lifecycle.pdf](http://www.greenhouse.gov.au/transport/pdfs/lifecycle.pdf).

41. For the 2000-01 to 2003-04 period, a total of AUD 75 million was allocated to fund the programme. Commonwealth of Australia, *Fuel Taxation Inquiry Report* (Pirie Printers Pty Ltd, 2002), at 203.

42. *Sustainable Development: Critical Issues*, supra note 2, at 84-85.

43. See note 15, supra.

44. *The Australian*, 7 March 2005, at 8.

45. This was the case with the Diesel Fuel Rebate Scheme and the Alternative Fuel Grants Scheme, discussed in note 38, supra.

ees (e.g. use of cars, discounted goods, entertainment and low-interest loans) in lieu of salary. The arrangements under the legislation encourage the increased use of private vehicles and hence the consumption of fuel, thereby compounding the problem of traffic congestion. The legislation provides significant concessions for employer-provided vehicles, even when not used for business or work-related purposes. Because the car is financed out of the employer's pre-tax income, this reduces the real cost of vehicle ownership by about 50%. In addition, under the concessional method for computing the FBT, higher rates are imposed on vehicles that travel shorter distances during the year (especially vehicles travelling less than 25,000 kilometres during the year). These arrangements provide incentives for behaviour that has a detrimental impact on the environment, such as:

- increased vehicle sales (as the after-tax price is reduced relative to other goods and services);
- a bias towards selecting larger and less fuel-efficient vehicles (as the additional costs of larger vehicles are reduced);
- increased vehicle use, particularly for commuting; and
- reduction in the use of alternative passenger transport options, in some cases reducing economic viability.<sup>46</sup>

As a result of these provisions, employer-provided cars are commonly included in employee-remuneration packages. It is estimated that around 40% of the passenger vehicles used in peak traffic periods are either corporately owned or provided as a fringe benefit.<sup>47</sup>

Redressing the anomalies of the FBT arrangements requires restructuring the existing taxes. This can be achieved by:

- introducing specific provisions favouring the use of more energy-efficient vehicles;
- confining FBT benefits to four-wheel drive vehicles to employees whose work requires the use of a vehicle; or
- tackling the FBT concessions in the context of a broad-based review of the tax system which provides a trade-off in the form of reduced tax rates in return for removing the concessions.

The second issue deals with the distortions that subsidies have on economic decisions. Broadly-based indirect taxes often provide for minimal exemptions. Such taxes exhibit greater features of tax neutrality as they tend to have a minimal impact on particular economic choices. The incidence of indirect taxes designed to raise revenue (as opposed to e.g. influencing behaviour) is expected to fall on consumers only. When such taxes are paid by businesses and not rebated, the tax cascades with the result that the incidence of the tax on different goods and services is uneven. This distorts relative prices, and therefore consumption and production patterns. For example, products which must be transported over long distances by road bear higher rates of effective tax than products which do not. These issues were considered by the Fuel Taxation Inquiry. Its report recommended, inter alia, reducing the adverse impact of the current tax system on the allocation of resources by restructuring the fuel tax system.<sup>48</sup>

In response to some of the recommendations in the *Fuel Taxation Inquiry Report*, the government flagged a phased removal of subsidies for petroleum-based substitute products in its *Energy White Paper*.<sup>49</sup> The *Energy White Paper* set out a time line for introducing a range of measures for fuel excise reform (for the period 1 July 2006 to 1 July 2015). The measures:

- propose a phased reduction of the excise for the business use of fuel in on-road applications of heavy commercial vehicles as well as off-road applications of fuel<sup>50</sup> by providing partial excise credits for fuels used in those applications. A major criticism of this measure is that it favours road use at the expense of rail freight and therefore perpetuates the dependency on fossil fuels;
- propose restructuring the energy taxes so that the fuel excise rates will be based on energy content rather than volume. It is hoped that this will encourage motorists to use renewable energy;
- provide a generous transition period which give industries such as LPG and new fuels time to establish themselves in the competitive marketplace; the excise exemption for alternative fuels is to be extended to 1 July 2011, after which such fuels will attract a 50% discount on energy content based on excise rates; and
- establish the Low Emissions Technology Development Fund to support low-emission technologies that could reduce greenhouse gases.

The removal or adjustment of the fiscal provisions (e.g. tax exemptions and subsidies) that have a detrimental effect on the environment should be done with caution because some subsidies are provided to support certain social objectives and sectors of the economy. Their sudden removal could lead to social disruption unless transitional measures are put in place through social support programmes. Further, a 1999 study by the International Energy Agency of eight of the largest countries outside the OECD<sup>51</sup> found that removing subsidies could reduce primary energy consumption by 13%, lower carbon dioxide emissions by 16% and increase GDP by almost 1% through higher economic efficiency.<sup>52</sup> For OECD countries, however, the scope for reducing the consumption of fossil fuels and related airborne emissions through the removal of subsidies was thought to be more modest.

46. Hatfield-Dodds, S., "When Should We Use Taxes to Address Environmental Issues? A Policy Framework and Practical Agenda for Australia", in Ashiabor et al. (eds.), supra note 22, at 347, 356.

47. *Reducing Car Dependency in Australia through Improved Remuneration Options – Background Information Paper*, National Transport Secretariat, Brisbane, Australia, 2000.

48. *Fuel Taxation Inquiry Report*, supra note 41, at 117-118.

49. *Securing Australia's Energy Future*, supra note 10, at 102.

50. This is targeted to benefit primary producers, mining businesses and the commercial generation of electricity for domestic applications, e.g. heating.

51. China, India, Indonesia, Iran, Kazakhstan, Russia, South Africa and Venezuela.

52. International Energy Agency, *World Energy Outlook: Insights 1999: Looking at Energy Subsidies Getting the Prices Right* (1999), at 15.

## 12. BEYOND RENEWABLES

In the overall context of fostering renewable energy technologies, two main sets of issues should be addressed by policy measures – increasing renewable energy capacity and promoting the development of energy-efficient technologies. The efforts to increase renewable energy capacity have been stymied by subsidies for fossil fuels, with the result that they have tilted the level playing field in favour of energy sources that are heavily polluting, artificially cheap and non-renewable. The roles of fiscal and direct regulatory measures in addressing the issue were examined at length in this article.

Taxes can be used to internalize environmental externalities, but they are not the most effective instrument in most cases. There is therefore a need for caution in mechanically attempting to link taxes with environmental effectiveness. While economic analysis suggests that fiscal policies may be the most economically efficient, such analyses often assume perfect market conditions and an ubiquitous “real actor”. It is possible to achieve gains in some areas with low levels of taxation. At the same time, however, it is worth pointing out that the environmental effectiveness of some taxes depends as much on the relative tax rates on related products (e.g. petrol and diesel) as on their absolute rates. In fostering the drive to embrace green taxes, one needs to be mindful of the fact that some green taxes are so effective that they destroy their tax base and thus yield little or no revenue.<sup>53</sup>

On the other hand, it can be argued that, despite the shortcomings of the fiscal instruments mentioned in the previous paragraph, perfection cannot be made an enemy of the good. The externalities associated with fossil fuel use still pose a real threat. In Australia, this means that, to effectively address this issue, the debate on introducing a carbon or energy tax (an issue rejected by the federal government in 2000) should be revisited. Most of the EU Member States have already introduced such a tax in one form or another.

Tax concessions for the development of petroleum substitutes have been slow to increase renewable energy capacity in the marketplace. The relegation of renewables to a small proportion of the transport fuel market is primarily attributable to the fact that these fuels:

- typically involve higher capital costs;
- are less convenient in terms of storage; and
- are relatively less energy-efficient than petroleum-based fuels.

It is unlikely that the slow pace in increasing renewable energy capacity is likely to change in the foreseeable future. In all probability, the expectation is that developments in new engine technology are likely to replace the dependence on petroleum products or their substitutes. This view is supported by an IEA study which found that the benefits for local air quality which motivated government subsidies for alternative fuels over the past decades are diminishing as emissions performance improves for conventional engines and fuels. The study noted that:

- most alternative fuels (including those derived from natural gas or LPG) do not offer significant green-

- house reductions over the conventional fuels used in engines manufactured to meet modern standards; and
- it was possible for renewable fuels from plant sources (ethanol or methanol) to bring about an 80% reduction in greenhouse gas emissions in the longer term, compared with fossil fuels.<sup>54</sup>

The IEA also noted that, given the current level of agricultural technologies and fuel-conversion processes, only ethanol from high sugar feedstock (e.g. sugar beets and sugar cane) and methanol from cellulosic materials could be considered as realistic options for large-scale fuel production. But to produce biofuels at levels which will bring about a significant displacement of petroleum-based fuels would require purpose-grown crops on a massive scale to produce the raw materials. For instance, the IEA estimated that, to produce sufficient ethanol from sugar beet to replace 10% of the demand for petroleum for transportation would require around 3% of total world cropland. The sheer scale required to produce the inputs and the potential external costs of such a venture<sup>55</sup> led the IEA to question the value of using scarce biomass resources for transportation, considering the renewable sectors’ high dependence on subsidies to maintain their viability.

This article has also highlighted the substantial strides that investment in the development of improved fuel standards and engine technologies have achieved in addressing some of the technical challenges faced by governments in their attempt to use taxes to internalize some of the external costs of energy use. For instance, the more efficient technologies developed for the combustion of fuel in motor vehicles (e.g. catalytic converters that improve air quality) have considerably improved air quality and reduced greenhouse gas emissions. The limitations of existing technology pose continuing challenges. This has created a situation in which some specific measures to improve greenhouse performance have been at odds with the objectives of improving air quality. For example, because diesel engines are more efficient than petrol engines, they have the potential of reducing greenhouse gas emissions per kilometre travelled. The flip side, however, is that diesel as an engine fuel is associated with the emission of higher levels of particulates and nitrous oxides than conventional petrol engines.

Vehicles powered by alternative fuels, such as electric and fuel cells or hybrid/electric engines (Toyota Prius and Honda Insight), are expected to bring about further improvements in fuel efficiency and emission reductions when compared with standard vehicles. The drawbacks are that the factors that influence demand for transport fuel change slowly. Further, it takes time for improvements in engine technology to become widespread in vehicle fleets.

53. In the experience of Ireland’s tax on plastic bags and Denmark’s tax on nickel-cadmium rechargeable batteries, for instance, the revenues diminished significantly soon after the taxes were introduced. This was due primarily to the fact that, because the environmentally damaging alternatives were not taxed, the environmental effectiveness of those taxes resulted in the near destruction of their tax bases.

54. *World Energy Outlook: Insights 2001*, supra note 31, at 265-266.

55. These include the availability of irrigated water, soil degradation, competition between crops for different fuels, and the opportunity cost of higher value agricultural production.

For instance, the high cost of alternative fuel-powered vehicles means that they cannot replace conventionally powered vehicles in the foreseeable future in such a way as to have a significant impact on the environment. The outlook is grim when one considers that the average age of Australia's vehicle fleet in 2003 was 10.4 years and that sales of new vehicles each year represent only 7% of the total stock of vehicles.<sup>56</sup> These considerations mean that the environmental impact of alternative fuel-powered vehicles could be minor. One way of addressing this is for governments to change their procurement policies by leasing and/or purchasing only more energy-efficient vehicles. While such vehicles have a high unit cost, the long-term benefit of such a policy is that the vehicles will trickle into the second-hand vehicle market and augment the fleet of green vehicles on the road. Developments such as these will reduce the reliance on fiscal instruments to encourage the use of environmentally friendly fuels.

Renewable energy's current share of total energy consumption remains small relative to non-renewable energy sources, and this is likely to be the case for a long time. Despite this, renewable energy capacity is expanding enormously from a small base. Continuing government funding and support through fiscal measures and other instruments will drive its growth in the future. In addressing the issue of fuel diversity, therefore, taxes and incentives will still play a vital role by fostering technological developments designed to increase renewable energy capacity.

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56. Australian Bureau of Statistics, *Motor Vehicle Census, Australia*, 31 March 2003.