

**ASSESSMENT OF CARBON TAX AS A POLICY  
OPTION FOR REDUCING CARBON-DIOXIDE  
EMISSIONS IN AUSTRALIA**

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## CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree, nor has it been submitted as part of the requirements for a degree, except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Candidate

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## ABSTRACT

This research has analysed the economy-wide impacts of carbon tax as a policy option to reduce the rate of growth of carbon-dioxide emissions from the electricity sector in Australia. These impacts are analysed for energy and non-energy sectors of the economy. An energy-oriented Input–Output framework, with ‘flexible’ production functions, based on Translog and Cobb–Douglas formulations, is employed for the analysis of various impacts. Further, two alternative conceptions of carbon tax are considered in this research, namely, based on Polluter Pays Principle (PPP) and Shared Responsibility Principle (SRP).

In the first instance, the impacts are analysed, for the period 2005–2020, for tax levels of \$10 and \$20 per tonne of CO<sub>2</sub>, in a situation of no *a-priori* limit on CO<sub>2</sub> emissions. The analysis shows that CO<sub>2</sub> emissions from the electricity sector, when carbon tax is based on PPP, would be 211 and 152 Mt, for tax levels of \$10 and \$20, respectively (as compared to 250 Mt in the Base Case scenario, that is, the business-as-usual case). The net economic costs, corresponding with these tax levels, expressed in *present value* terms, would be \$27 and \$49 billion, respectively, over the period 2005–2020. These economic costs are equivalent to 0.43 and 0.78 per cent of the estimated GDP of Australia. Further, most of the economic burden, in this instance, would fall on the electricity sector, particularly coal-fired electricity generators – large consumers of direct fossil fuel. On the other hand, in the case of a carbon tax based on SRP, CO<sub>2</sub> emissions would be 172 and 116 Mt, for tax levels of \$10 and \$20, respectively. The corresponding net economic costs would be \$47 (0.74 per cent of GDP) and \$84 (1.34 per cent of GDP) billion, respectively, with significant burden felt by the commercial sector – large consumers of indirect energy and materials whose production would contribute to CO<sub>2</sub> emissions.

Next, the impacts are analysed by placing an *a-priori* limit on CO<sub>2</sub> emissions from the electricity sector – equivalent to 108 per cent of the 1990 level (that is, 138 Mt), by the year 2020. Two cases are analysed, namely, *early action* (carbon tax introduced in 2005) and *deferred action* (carbon tax introduced in 2010). In the case of early action, the analysis suggests, carbon tax of \$25 and \$15, based on PPP and SRP, respectively,

would be required to achieve the above noted emissions target. The corresponding tax levels in the case of deferred action are \$51 and \$26, respectively. This research also shows that the net economic costs, in the case of early action, would be \$32 billion (for PPP) and \$18 billion (for SRP) higher than those in the case of deferred action. However, this research has demonstrated, that this inference is largely due to the selection of particular indicator (that is, *present value*) and the relatively short time-frame (that is, 2005–2020) for analysis. By extending the time-frame of the analysis to the year 2040, the case for an early introduction of carbon tax strengthens.

Overall, the analysis in this research suggests that an immediate introduction of carbon tax, based on SRP, is the most attractive approach to reduce the rate of growth of CO<sub>2</sub> emissions from the electricity sector and to simultaneously meet economic and social objectives. If the decision to introduce such a tax is deferred, it would be rather difficult to achieve not only environmental objectives but economic and social objectives as well.

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## ABBREVIATIONS/GLOSSARY

|         |  |
|---------|--|
| AAEC    | Australian Atomic Energy Commission  |
| ABARE   | Australian Bureau of Agricultural and Resource Economics                               |
| ABRCC   | Australian Business Roundtable on Climate Change                                       |
| ABS     | Australian Bureau of Statistics  |
| ACA     | Australian Coal Association  |
| ACARP   | Australian Coal Association Research Program   |
| AGO     | Australian Greenhouse Office   |
| ASFF    | Australian Stocks and Flows Framework  |
| BCA     | Business Council of Australia  |
| BCSE    | Business Council for Sustainable Energy  |
| CCS     | Carbon Capture and Sequestration   |
| CES     | Constant Elasticity of Substitution  |
| CISS    | Coal in a Sustainable Society  |
| COAG    | Council of Australian Government   |
| COP     | Conference of the Parties  |
| CSIRO   | Commonwealth Scientific and Industrial Research Organisation                           |
| DITR    | Department of Industry, Tourism and Resources  |
| ECNSW   | Electricity Commission of New South Wales  |
| ERAA    | Energy Retailers Association of Australia  |
| ESAA    | Electricity Supply Association of Australia  |
| ESD     | Ecologically Sustainable Development   |
| ESI     | Electricity Supply Industry  |
| ETSA    | Electricity Trust of South Australia   |
| GCP     | Greenhouse Challenge Program   |
| GDP     | Gross Domestic Product   |
| GHG     | Greenhouse-gas   |
| IEA     | International Energy Agency  |
| IHA     | International Hydro Association  |
| IPCC    | Intergovernmental Panel on Climate Change  |
| LCA     | Life-cycle Analysis  |
| LETAG   | Lower Emissions Technology Advisory Group  |
| LETDF   | Low Emissions Technology Demonstration Fund  |
| MARKAL  | MARKet ALlocation  |
| MATTER  | MATerials Technologies for greenhouse-gas Emission Reduction                           |
| MESSAGE | Model for Energy Supply Strategy Alternatives and their General Environmental impacts  |
| MFA     | Material Flow Analysis   |
| MIMES   | Model for description and optimisation of Integrated Material flows and Energy Systems |
| MRET    | Mandatory Renewable Energy Target  |
| Mt      | Million tonnes   |
| NEM     | National Electricity Market  |

|          |  |
|----------|--|
| NGAP     | National Greenhouse Advisory Panel                     |
| NGGIC    | National Greenhouse Gas Inventory Committee            |
| NGRS     | National Greenhouse Response Strategy                  |
| NGS      | National Greenhouse Strategy                           |
| NGSC     | National Greenhouse Steering Committee                 |
| NIEIR    | National Institute of Economic and Industry Research   |
| OECD     | Organisation for Economic Co-operation and Development |
| PJ       | Petajoules   |
| ppmv     | Parts per million by volume                            |
| PPP      | Polluter Pays Principle                                |
| RBA      | Reserve Bank of Australia                              |
| RES      | Reference Energy System                                |
| RMS      | Reference Material System                              |
| RRI      | Resource Research Institute                            |
| SECV     | State Electricity Commission of Victoria               |
| SMHES    | Snowy Mountains Hydro Electric Scheme                  |
| SRP      | Shared Responsibility Principle                        |
| TIC      | Techno-Institutional Complex                           |
| Translog | Transcendental Logarithmic                             |
| UNFCCC   | United Nations Framework Convention on Climate Change  |