Recalculating the Impact of the Carbon Tax

How changes to global carbon accounting standards will wipe out household over-compensation

Briefing Note

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1.0 Executive Summary

By the end of this year household carbon tax 'over-compensation' will be wiped out by changes to the global carbon accounting rules used to calculate the environmental impact of greenhouse gases.

The changes will:

- Increase Australia's emissions profile by the equivalent of 22 million tonnes of carbon dioxide per annum.
- Increase the cost impact of the carbon tax by nearly $230 million per annum.
- Increase the average carbon tax impost to households, thus wiping out 'over-compensation'.
- Ensure the average Australian household is worse off under the carbon tax.

The emissions and cost increases results from amendments to the methodology used to assess the environmental impact of greenhouse gases under the Kyoto Protocol. Not all greenhouse gases are the same. Some gases capture more heat and stay in the atmosphere longer. As a result they are converted into their equivalent global warming potential to carbon dioxide.

For example, according to the Intergovernmental Panel on Climate Change's Second Assessment Report, methane stays in the atmosphere for approximately 12 years and is 21 times more potent than carbon dioxide. Nitrous oxide stays in the atmosphere for 120 years and is 310 times more potent than carbon dioxide. All of Australia's calculations of the environmental impact of greenhouse gases are based on the IPCC's Second Assessment Report.

At the end of this year the environmental impact of greenhouse gases will be amended under the Kyoto Protocol. Post-2012 the Protocol will require the calculations to be updated to the data used in the IPCC's Fourth Assessment Report. Australia has already agreed to make this change.

The calculations in the IPCC's Fourth Assessment Report predominantly increase the environmental impact of greenhouse gases, and a small number decrease their environmental impact.

Due to the IPCC's recalculations, Australia's greenhouse gas profile will increase by approximately 22 million tonnes per annum. The biggest increase comes from the upward revision of the environmental impact of methane by around 20 per cent.

This revision of the method for recalculating emissions will increase the volume of greenhouse gas that will attract a carbon tax. When agricultural emissions are removed, Australia's emissions profile still increases by 10 million tonnes per annum. Adding another 10 million tonnes will increase Australia's carbon tax bill by between $227 million per annum (based on 2009 data) and $229 million per annum (2010 data).

These calculations are based on the same data the Commonwealth Treasury used in its *Strong Growth, Low Pollution* modelling of the impact of the carbon tax. Treasury used 2009 emissions data. The latest publicly available data is from 2010.

According to the federal government's carbon tax household assistance package the average Australian household will pay a carbon tax of $9.90 a week ($514.80 per year) and will be 'over-compensated' by $10.10 ($525.20 per year). Based on the government's data households will be 'over-compensated' by $0.20 per week ($10.40 per year).

The increase in Australia's carbon tax bill equates to an additional impost of approximately $30 per household per annum and would wipe out the government's $10.40 per household per year carbon tax 'over-compensation'.

2.0 Abbreviations

ABS	Australian Bureau of Statistics
C_2F_6	Perfluoroethane (Hexafluoroethane)
$C_2H_3F_3$	Hydroflurocarbon (Trifluoroethane)
C_2HF_5	Hydroflurocarbon (Pentafluoroethane)
C_4F_{10}	Perfluorobutane
CF_4	Perfluoromethane (Tetrafluoromethane)
CH_2FCF_3	Hydroflurocarbon (Tetrafluoroethane)
CH_4	Methane
CHF_3	Hydroflurocarbon (Fluoroform)
CO_2	Carbon dioxide
$CO_{2\text{-}e}$	Carbon dioxide equivalent
DCCEE	Department of Climate Change and Energy Efficiency
FAR	Fourth Assessment Report of the Intergovernmental Panel on Climate Change
GG	Gigagrams
GWP	Global warming potential
GHG	Greenhouse gas
IPA	Institute of Public Affairs
IPCC	Intergovernmental Panel on Climate Change
Kyoto I	The first commitment period of the Kyoto Protocol (2008 – 2012)
Kyoto II	The second commitment period of the Kyoto Protocol (post 2012)
N_2O	Nitrous oxide
SAR	Second Assessment Report of the Intergovernmental Panel on Climate Change
SF_6	Sulphur hexafluoride
t	Tonnes
UNFCCC	United Nations Framework Convention on Climate Change

3.0 Converting Greenhouse Gases

Not all greenhouse gases are the same. Each has a different global warming potential. A gas with a higher GWP essentially captures more heat than carbon dioxide and/or stays in the atmosphere for a longer time than carbon dioxide, increasing its possible contribution to capturing heat.

Because different greenhouse gases have different GWPs it is useful to convert them to an equivalent environmental impact in terms of the most common greenhouse gas emitted by humans – carbon dioxide, or CO_2.

When a greenhouse gas is converted to CO_2 its GWP is reflected in its carbon dioxide equivalence, or $CO_{2\text{-}e}$.

For example, methane (CH_4) is less commonly emitted by humans than CO_2. But, it has a much higher GWP than CO_2 and therefore the calculations of its GWP have a significant impact on a country's emissions profile.

When methane is converted to $CO_{2\text{-}e}$ it needs to be multiplied by a factor of 21 to be equivalent to CO_2, according to the IPCC's SAR[1] and as required under the Kyoto Protocol.[2]

Put simply:

1 tonne of methane = 21 tonnes of carbon dioxide equivalent greenhouse gases

or

$$1t\ CH_4 = 21t\ CO_{2\text{-}e}$$

As outlined in Table 1, other gases also have different GWPs.

[1] Intergovernmental Panel on Climate Change. 1995. "IPCC Second Assessment: Climate Change 1995". Available at http://ipcc.ch/pdf/climate-changes-1995/ipcc-2nd-assessment/2nd-assessment-en.pdf.
[2] United Nations Framework Convention on Climate Change. 1997. "Kyoto Protocol". Available at http://unfccc.int/resource/docs/convkp/kpeng.html.

Table 1 | Select global warming potentials of greenhouse gases for the Kyoto Protocol

Greenhouse gas	Chemical formula	Second assessment report		
		20 years	100 years	500 years
Carbon dioxide	CO_2	1	1	1
Methane	CH_4	56	21	6.5
Nitrous oxide	N_2O	280	310	170
Hydroflurocarbon (Fluoroform)	CHF_3	9,100	11,700	9,800
Hydroflurocarbon (Pentafluoroethane)	C_2HF_5	4,600	2,800	920
Hydroflurocarbon (Tetrafluoroethane)	CH_2FCF_3	2,900	1,300	310
Hydroflurocarbon (Trifluoroethane)	$C_2H_3F_3$	8,000	3,800	1,400
Perfluoromethane (Tetrafluoromethane)	CF_4	4,400	6,500	10,000
Perfluoroethane (Hexafluoroethane)	C_2F_6	6,200	9,200	14,000
Perfluorobutane	C_4F_{10}	4,800	7,000	10,100
Sulphur hexafluoride	SF_6	16,300	23,900	34,900

All calculations for Australia’s carbon tax, including its cost impact on business and households, is based on the Kyoto standard from the IPCC’s SAR.

4.0 The Kyoto Protocol

Reducing the concentration of greenhouse gas emissions in the atmosphere is only worthwhile if it is done globally. The efforts of a single country are pointless if another country increases emissions.

A tonne of emissions from China has the same environmental impact as a tonne from Australia. The externality is also the same.

With Australia having introduced a carbon tax on 1 July 2012 it is in Australia's economic and environmental interests that other countries impose a similar cost. Currently no other country is imposing a fixed price or floating carbon tax as large or economically broad as Australia's.

A key pillar for securing equivalent support from other countries is securing international treaties with emissions reduction obligations. These treaties are negotiated through the United Nations Framework Convention on Climate Change.

The only successful treaty to be negotiated through the UNFCCC process is the Kyoto Protocol.

In 1997 the Howard government signed the Kyoto Protocol. In 2007 the Rudd government ratified it bringing the Kyoto Protocol into force.

Under Kyoto, developed countries are bound to reduce their greenhouse gas emissions. Australia is required to reduce its emissions by 108 per cent from 1990 $CO_{2\text{-}e}$ levels. Put differently, Australia is allowed to increase its emissions by eight per cent from 1990 $CO_{2\text{-}e}$ levels.

The calculations for Australia's greenhouse gas emissions are based on converting the GWP of all gases to their carbon dioxide equivalence in the Second Assessment Report of the Intergovernmental Panel on Climate Change.

In 2005, Kyoto came into force for those countries that ratified it. The first commitment period to cut emissions operates from 1 January 2008 until 31 December 2012.

On 1 January 2013 the Kyoto Protocol, and with it the international architecture for cutting global greenhouse gas emissions, will expire – unless a second commitment period is agreed upon.

Since at least 2007, governments have officially sought to negotiate the extension of the Kyoto Protocol through a second commitment period.

The spectacular collapse at the 2009 Copenhagen Summit was largely a result of the fact that developed countries wanted Kyoto to expire and be replaced with a new agreement that included all countries.

At the 2011 Durban Summit countries agreed to extend Kyoto, though the details of its extension have not been resolved. The Durban Summit also established a process for a new agreement to succeed Kyoto after 2020. Negotiations for that new agreement are intended to conclude by December 2015.

At the 2011 Durban Summit, UNFCCC Parties agreed to include revised calculations for assessing the global warming potential of greenhouse gases. In the decisions of the Durban Summit it was agreed that the Kyoto Protocol would use the GWPs of greenhouse gases included in the Fourth Assessment Report of the IPCC.

Currently the Kyoto Protocol requires the use of GWP in the Second Assessment Report of the IPCC.

According to Decision 4/CMP.7, countries agreed to new 'common metrics'. The section states:

> *The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol … Decides that, for the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of the greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled "Global Warming Potential for Given Time Horizon" in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon, taking into account the inherent and complicated uncertainties involved in global warming potential estimates.*[3]

The IPCC's revised GWPs for greenhouse gases are available in the FAR and are predominantly revised upward from the SAR.[4]

[3] United Nations Framework Convention on Climate Change. 2011. "Decision 1/CMP.7: Outcome of the work of the work of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol at its sixteenth session", FCCC/KP/CMP/2011/10/Add.1. Available at http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf#page=2.
[4] Intergovernmental Panel on Climate Change. 2007. "Fourth Assessment Report: Climate Change 2007". Available at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html.

5.0 Kyoto II's Sting

As part of the negotiations for a second Kyoto Protocol commitment period, there is a sting that has gone unnoticed in negotiations to the agreement.

In Kyoto's first commitment period the calculations for converting methane into equivalent carbon dioxide emissions was based on the IPCC's SAR.

As outlined in the previous section, according to Decision 4/CMP.7 from the Durban Summit the GWPs for Kyoto II are required to come from the IPCC's FAR.

As Table 2 outlines, some GWPs have decreased, but most have increased.

Table 2 | Select global warming potentials of greenhouse gases

Greenhouse gas	Chemical formula	Second assessment report			Fourth assessment report			Change between SAR and FAR
		20 years	100 years	500 years	20 years	100 years	500 years	
Carbon dioxide	CO_2	1	1	1	1	**1**	1	0%
Methane	CH_4	56	21	6.5	72	**25**	7.6	19%
Nitrous oxide	N_2O	280	310	170	289	**298**	153	-4%
Hydroflurocarbon (Fluoroform)	CHF_3	9,100	11,700	9,800	12,000	**14,800**	12,200	26%
Hydroflurocarbon (Pentafluoroethane)	C_2HF_5	4,600	2,800	920	6,350	**3,500**	1,100	25%
Hydroflurocarbon (Tetrafluoroethane)	CH_2FCF_3	2,900	1,300	310	3,830	**1,430**	435	10%
Hydroflurocarbon (Trifluoroethane)	$C_2H_3F_3$	8,000	3,800	1,400	5,890	**4,470**	1,590	18%
Perfluoromethane (Tetrafluoromethane)	CF_4	4,400	6,500	10,000	5,210	**7390**	11,200	14%
Perfluoroethane (Hexafluoroethane)	C_2F_6	6,200	9,200	14,000	8,630	**12,200**	18,200	33%
Perfluorobutane	C_4F_{10}	4,800	7,000	10,100	No noted change			No noted change
Sulphur hexafluoride	SF_6	16,300	23,900	34,900	16,300	**22,800**	32,600	-5%

Note: Green shaded GWPs are those required to be used under Kyoto I and the blue shaded GWPs are those required to be used under Kyoto II.

Of the gases listed above, and of all gases included in the IPCC's FAR, the three gases that matter most are carbon dioxide, methane and nitrous oxide. Those three gases are the most commonly emitted gases. Methane's GWP has increased by 19 per cent, and nitrous oxide's GWP has decreased by four per cent.

If Australia wishes to remain Party to the international framework for cutting emissions, which would be required to take advantage of international emissions trading and to be consistent with the conclusions of Treasury's *Strong Growth, Low Pollution* modelling, the revised GWPs will need to be adopted in Australia's regulations.

6.0 The Impact of Revising Australia's GWPs

Australia's emissions are available from the National Greenhouse Gas Inventory, operated by the Department of Climate Change and Energy Efficiency. The National Greenhouse Gas Inventory explicitly states that calculations are made using the Kyoto I accounting framework.

As Table 3 outlines, the predominant impact is on methane emissions.

Table 3 shows that based on the Kyoto GWPs Australia's methane emissions were 114,037,220 $CO_{2\text{-}e}$ and 111,619,560 $CO_{2\text{-}e}$ in 2009 and 2010 respectively. But when they are adjusted for the Kyoto II GWPs they increase by a further 21,721,280 $CO_{2\text{-}e}$ and 21,260,940 $CO_{2\text{-}e}$ to 135,758,500 $CO_{2\text{-}e}$ and 132,880,500 $CO_{2\text{-}e}$ respectively.

Table 3 | Increase in emissions from publicly available National Greenhouse Gas Inventory data based on revised GWPs under Kyoto II, including agriculture (tonnes)

Gas	2009	2010
CH_4	21,721,280.00	21,260,940.00
N_2O	-972,750.00	-902,450.00
C_2HF_5	364,000.00	392,000.00
CH_2FCF_3	416,000.00	439,400.00
$C_2H_3F_3$	13,400.00	13,400.00
SF_6	-11,000.00	-11,000.00
CF_4	35,600.00	26,700.00
C_2F_6	14,667.39	10,643.48
Total	**21,581,197.39**	**21,229,633.48**

Source: IPA calculations based on National Greenhouse Gas Inventory data

Calculating the impact of the revised calculations on the carbon tax requires the exclusion of agriculture, which is not covered by the tax. As Table 4 outlines, excluding agriculture essentially halves the increase of emissions from methane and slashes the decrease in emissions from nitrous oxide by four fifths.

Table 4 | Increase in emissions from publicly available National Greenhouse Gas Inventory data based on revised GWPs under Kyoto II, excluding agriculture (tonnes)

Gas	2009	2010
CH_4	9,273,660.00	9,338,790.00
N_2O	-251,370.00	-248,290.00
C_2HF_5	364,000.00	392,000.00
CH_2FCF_3	416,000.00	439,400.00
$C_2H_3F_3$	13,400.00	13,400.00
SF_6	-11,000.00	-11,000.00
CF_4	35,600.00	26,700.00
C_2F_6	14,667.39	10,643.48
Total	**9,854,957.39**	**9,961,643.48**

Source: IPA calculations based on National Greenhouse Gas Inventory data

When emissions are calculated using the Kyoto II accounting standards and multiplied by the $23 per tonne $CO_{2\text{-}e}$ carbon price, the difference in calculations increases the impact of the carbon tax by between $227 million and $229 million per annum.

Table 5 | Carbon tax impact of using Kyoto II accounting standards (AUD$)

Gas	2009	2010
CH_4	$213,294,180.00	$214,792,170.00
N_2O	-$5,781,510.00	-$5,710,670.00
C_2HF_5	$8,372,000.00	$9,016,000.00
CH_2FCF_3	$9,568,000.00	$10,106,200.00
$C_2H_3F_3$	$308,200.00	$308,200.00
SF_6	-$253,000.00	-$253,000.00
CF_4	$818,800.00	$614,100.00
C_2F_6	$337,350.00	$244,800.00
Total	**$226,664,020.00**	**$229,117,800.00**

Source: IPA calculations

As Table 6 shows, using ABS data, when the cost of the increase in the carbon taxed is passed onto households, the cost impact for the average Australian household will be around $27 per annum and thus it will wipe out the over-compensation from the tax offered by the Gillard government.

Table 6 | Carbon tax impact of using Kyoto II accounting standards for the average household (AUD$)

Gas	2009	2010
CH_4	$25.89	$25.59
N_2O	-$0.70	-$0.68
C_2HF_5	$1.02	$1.07
CH_2FCF_3	$1.16	$1.20
$C_2H_3F_3$	$0.04	$0.04
SF_6	-$0.03	-$0.03
CF_4	$0.10	$0.07
C_2F_6	$0.04	$0.03
Total	**$27.52**	**$27.29**

Source: IPA calculations using ABS data

7.0 Available National Greenhouse Gas Inventory Data and Calculations

Table 7 | Australia's methane emissions, gigagrams (GG)

Category	Methane adjustment (CH_4)									
	Kyoto I (1t CH_4 = 21t CO_{2-e})				Revised Kyoto II (1t CH_4 = 25t CO_{2-e})					
	2009		2010		2009			2010		
	CH_4	CO_{2-e}	CH_4	CO_{2-e}	CH_4	CO_{2-e}	Difference	CH_4	CO_{2-e}	Difference
National Greenhouse Gas Inventory Total	**5,430.34**	**114,037.22**	**5,315.22**	**111,619.56**	**5,430.34**	**135,758.50**	**21,721.28**	**5,315.22**	**132,880.50**	**21,260.94**
Energy	**1,626.78**	**34,162.31**	**1,634.18**	**34,317.73**	**1,626.78**	**40,669.50**	**6,507.19**	**1,634.18**	**40,854.50**	**6,536.77**
Fuel Combustion	83.47	1,752.79	82.96	1,742.26	83.47	2,086.75	333.96	82.96	2,074.00	331.74
Fugitive Emissions From Fuels	1,543.31	32,409.52	1,551.21	32,575.47	1,543.31	38,582.75	6,173.23	1,551.21	38,780.25	6,204.78
Industrial Processes	**2.96**	**62.13**	**3.13**	**65.75**	**2.96**	**74.00**	**11.87**	**3.13**	**78.25**	**12.50**
Chemical Industry	0.58	12.13	0.58	12.13	0.58	14.50	2.37	0.58	14.50	2.37
Metal Production	2.38	50.00	2.55	53.62	2.38	59.50	9.50	2.55	63.75	10.13
Agriculture	**3,111.88**	**65,349.38**	**2,980.53**	**62,591.10**	**3,111.88**	**77,797.00**	**12,447.62**	**2,980.53**	**74,513.25**	**11,922.15**
Enteric Fermentation	2,606.26	54,731.43	2,566.45	53,895.41	2,606.26	65,156.50	10,425.07	2,566.45	64,161.25	10,265.84
Manure Management	83.39	1,751.10	82.38	1,730.02	83.39	2,084.75	333.65	82.38	2,059.50	329.48
Rice Cultivation	2.20	46.28	8.32	174.77	2.20	55.00	8.72	8.32	208.00	33.23
Prescribed Burning of Savannahs	409.73	8,604.24	312.39	6,560.25	409.73	10,243.25	1,639.01	312.39	7,809.75	1,249.50
Field Burning of Agricultural Residues	10.30	216.33	10.98	230.64	10.30	257.50	41.17	10.98	274.50	43.86
Waste	**633.63**	**13,306.29**	**648.82**	**13,625.32**	**633.63**	**15,840.75**	**2,534.46**	**648.82**	**16,220.50**	**2,595.18**
Solid Waste Disposal on Land	517.12	10,859.56	530.47	11,139.86	517.12	12,928.00	2,068.44	530.47	13,261.75	2,121.89
Wastewater Handling	113.50	2,383.57	114.95	2,414.00	113.50	2,837.50	453.93	114.95	2,873.75	459.75
Other	3.01	63.17	3.40	71.45	3.01	75.25	12.08	3.40	85.00	13.55
Land Use, Land-Use Change and Forestry KP	**55.10**	**1,157.11**	**48.56**	**1,019.67**	**55.10**	**1,377.50**	**220.39**	**48.56**	**1,214.00**	**194.33**
Afforestation and reforestation	0.01	0.14	0.00	0.04	0.01	0.25	0.11	0.00	0.00	-0.04
Deforestation	55.09	1,156.97	48.55	1,019.62	55.09	1,377.25	220.28	48.55	1,213.75	194.13

Source data: National Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

Table 8 | Australia's nitrous oxide emissions, gigagrams (GG)

Category	Nitrous oxide adjustment (N_2O)									
	Kyoto I (1t N_2O = 310t CO_{2-e})				Kyoto II (1t N_2O = 298t CO_{2-e})					
	2009		2010		2009			2010		
	N_2O	CO_{2-e}	N_2O	CO_{2-e}	N_2O	CO_{2-e}	Difference	N_2O	CO_{2-e}	Difference
National Greenhouse Gas Inventory Total	**81.19**	**25,167.37**	**75.11**	**23,285.23**	**81.19**	**24,194.62**	**-972.75**	**75.11**	**22,382.78**	**-902.45**
Energy	**9.02**	**2,795.37**	**8.58**	**2,659.22**	**9.02**	**2,687.96**	**-107.41**	**8.58**	**2,556.84**	**-102.38**
Fuel Combustion	8.91	2,762.82	8.47	2,624.51	8.91	2,655.18	-107.64	8.47	2,524.06	-100.45
Fugitive Emissions From Fuels	0.10	32.54	0.11	34.71	0.10	29.80	-2.74	0.11	32.78	-1.93
Industrial Processes	**10.11**	**3,135.32**	**10.58**	**3,280.96**	**10.11**	**3,012.78**	**-122.54**	**10.58**	**3,152.84**	**-128.12**
Chemical Industry	10.07	3,121.38	10.53	3,263.83	10.07	3,000.86	-120.52	10.53	3,137.94	-125.89
Metal Production	0.04	13.94	0.06	17.14	0.04	11.92	-2.02	0.06	17.88	0.74
Agriculture	**60.13**	**18,640.12**	**54.50**	**16,895.16**	**60.13**	**17,918.74**	**-721.38**	**54.50**	**16,241.00**	**-654.16**
Manure Management	5.04	1,563.91	5.08	1,573.53	5.04	1,501.92	-61.99	5.08	1,513.84	-59.69
Agricultural soils	45.94	14,240.68	42.48	13,167.87	45.94	13,690.12	-550.56	42.48	12,659.04	-508.83
Prescribed Burning of Savannahs	8.83	2,737.86	6.62	2,051.91	8.83	2,631.34	-106.52	6.62	1,972.76	-79.15
Field Burning of Agricultural Residues	0.32	97.66	0.33	101.85	0.32	95.36	-2.30	0.33	98.34	-3.51
Waste	**1.41**	**437.58**	**1.36**	**420.74**	**1.41**	**420.18**	**-17.40**	**1.36**	**405.28**	**-15.46**
Wastewater Handling	1.39	429.49	1.33	411.60	1.39	414.22	-15.27	1.33	396.34	-15.26
Other	0.03	8.09	0.03	9.15	0.03	8.94	0.85	0.03	8.94	-0.21
Land Use, Land-Use Change and Forestry KP	**0.51**	**158.98**	**0.09**	**29.15**	**0.51**	**151.98**	**-7.00**	**0.09**	**26.82**	**-2.33**
Afforestation and reforestation	0.00	0.04	0.00	0.01	0.00	0.00	-0.04	0.00	0.00	-0.01
Deforestation	0.51	158.94	0.09	29.13	0.51	151.98	-6.96	0.09	26.82	-2.31

Source data: National Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

Table 9 | Australia's pentafluoroethane emissions, gigagrams (GG)

Category	Pentafluoroethane Adjustment (C_2HF_5)									
	Kyoto I (1t C_2HF_5 = 2,800t $CO_{2\text{-}e}$)				Revised Kyoto II (1t C_2HF_5 = 3,500t $CO_{2\text{-}e}$)					
	2009		2010		2009			2010		
	C_2HF_5	$CO_{2\text{-}e}$	C_2HF_5	$CO_{2\text{-}e}$	C_2HF_5	$CO_{2\text{-}e}$	Difference	C_2HF_5	$CO_{2\text{-}e}$	Difference
National Greenhouse Gas Inventory Total	**0.52**	**1,456.00**	**0.56**	**1,568.00**	**0.52**	**1,820.00**	**364.00**	**0.56**	**1,960.00**	**392.00**
Industrial processes	**0.52**	**1,456.00**	**0.56**	**1,568.00**	**0.52**	**1,820.00**	**364.00**	**0.56**	**1,960.00**	**392.00**
Consumption of halocarbons and Sulphur Hexafluoride	0.52	1,456.00	0.56	1,568.00	0.52	1,820.00	364.00	0.56	1,960.00	392.00

Source data: Australia's Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

Table 10 | Australia's Tetrafluoroethane emissions, gigagrams (GG)

Category	Tetrafluoroethane (CH_2FCF_3)									
	Kyoto I (1t CH_2FCF_3 = 1,300t $CO_{2\text{-}e}$)				Revised Kyoto II (1t CH_2FCF_3 = 1,430t $CO_{2\text{-}e}$)					
	2009		2010		2009			2010		
	CH_2FCF_3	$CO_{2\text{-}e}$	CH_2FCF_3	$CO_{2\text{-}e}$	CH_2FCF_3	$CO_{2\text{-}e}$	Difference	CH_2FCF_3	$CO_{2\text{-}e}$	Difference
National Greenhouse Gas Inventory Total	**3.20**	**4,160.00**	**3.38**	**4,394.00**	**3.20**	**4,576.00**	**416.00**	**3.38**	**4,833.40**	**439.40**
Industrial processes	**3.20**	**4,160.00**	**3.38**	**4,394.00**	**3.20**	**4,576.00**	**416.00**	**3.38**	**4,833.40**	**439.40**
Consumption of halocarbons and Sulphur Hexafluoride	3.20	4,160.00	3.38	**4,394.00**	3.20	4,576.00	416.00	3.38	4,833.40	439.40

Source data: National Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

Table 11 | Australia's trifluoroethane emissions, gigagrams (GG)

Category	Trifluoroethane ($C_2H_3F_3$)									
	Kyoto I (1t $C_2H_3F_3$ = 3,800t $CO_{2\text{-}e}$)				Revised Kyoto II (1t $C_2H_3F_3$ = 4,470t $CO_{2\text{-}e}$)					
	2009		2010		2009			2010		
	$C_2H_3F_3$	$CO_{2\text{-}e}$	$C_2H_3F_3$	$CO_{2\text{-}e}$	$C_2H_3F_3$	$CO_{2\text{-}e}$	Difference	$C_2H_3F_3$	$CO_{2\text{-}e}$	Difference
National Greenhouse Gas Inventory Total	**0.02**	**76.00**	**0.02**	**76.00**	**0.02**	**89.40**	**13.40**	**0.02**	**89.40**	**13.40**
Industrial processes	**0.02**	**76.00**	**0.02**	**76.00**	**0.02**	**89.40**	**13.40**	**0.02**	**89.40**	**13.40**
Consumption of halocarbons and Sulphur Hexafluoride	0.02	76.00	0.02	76.00	0.02	89.40	13.40	0.02	89.40	13.40

Source data: National Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

Table 12 | Australia's Sulphur hexafluoride emissions, gigagrams (GG)

Category	Sulphur hexafluoride (SF_6)									
	Kyoto I (1t SF_6 = 23,900t $CO_{2\text{-}e}$)				Revised Kyoto II (1t SF_6 = 22,800t $CO_{2\text{-}e}$)					
	2009		2010		2009			2010		
	SF_6	$CO_{2\text{-}e}$	SF_6	$CO_{2\text{-}e}$	SF_6	$CO_{2\text{-}e}$	Difference	SF_6	$CO_{2\text{-}e}$	Difference
National Greenhouse Gas Inventory Total	**0.01**	**239.00**	**0.01**	**239.00**	**0.01**	**228.00**	**-11.00**	**0.01**	**228.00**	**-11.00**
Industrial processes	**0.01**	**239.00**	**0.01**	**239.00**	**0.01**	**228.00**	**-11.00**	**0.01**	**228.00**	**-11.00**
Consumption of halocarbons and Sulphur Hexafluoride	0.01	239.00	0.01	**239.00**	0.01	228.00	-11.00	0.01	228.00	-11.00

Source data: National Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

Table 13 | Australia's perfluoromethane emissions, giga grams (GG)

Category	Perfluoromethane (CF_4)									
	Kyoto I (1t CF_4 = 6,500t CO_{2-e})				Revised Kyoto II (1t CF_4 = 7,390t CO_{2-e})					
	2009		2010		2009			2010		
	CF_4	CO_{2-e}	CF_4	CO_{2-e}	CF_4	CO_{2-e}	Difference	CF_4	CO_{2-e}	Difference
National Greenhouse Gas Inventory Total	**0.04**	**260.00**	**0.03**	**195.00**	**0.04**	**295.60**	**35.60**	**0.03**	**221.70**	**26.70**
Industrial processes	**0.04**	**260.00**	**0.03**	**195.00**	**0.04**	**295.60**	**35.60**	**0.03**	**221.70**	**26.70**
Metal production	0.04	260.00	0.03	195.00	0.04	295.60	35.60	0.03	221.70	26.70

Source data: National Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

Table 14 | Australia's hexafluoroethane emissions, gigagrams (GG)

Category	Hexafluoroethane (C_2F_6)									
	Kyoto I (1t C_2F_6 = 9,200t CO_{2-e})				Revised Kyoto II (1t C_2F_6 = 12,200t CO_{2-e})					
	2009		2010		2009			2010		
	C_2F_6	CO_{2-e}	C_2F_6	CO_{2-e}	C_2F_6	CO_{2-e}	Difference	C_2F_6	CO_{2-e}	Difference
National Greenhouse Gas Inventory Total	**0.00**	**44.98**	**0.00**	**32.64**	**0.00**	**59.65**	**14.67**	**0.00**	**43.28**	**10.64**
Industrial processes	**0.00**	**44.98**	**0.00**	**32.64**	**0.00**	**59.65**	**14.67**	**0.00**	**43.28**	**10.64**
Metal production	0.00	44.98	0.00	**32.64**	0.00	59.65	14.67	0.00	43.28	10.64

Source data: National Greenhouse Gas Inventory, www.ageis.climatechange.gov.au and IPA calculations

8.0 About the Institute of Public Affairs

The Institute of Public Affairs, founded in 1943, is the world's oldest free market think tank. The IPA is a not-for-profit research institute based in Melbourne, Australia with staff and associates based around Australia. Think tanks act as public policy incubators and develop public policy solutions.

The objective of the IPA is to promote evidence-based public policy solutions rooted in the liberal tradition of free markets and a free society. The IPA achieves these objectives by undertaking and disseminating research; participating in national and international policy debate through the media; and engaging with opinion leaders, stakeholders and public policy makers.

All work completed by the IPA is published in the public domain for the consumption of governments, politicians, domestic and international policy makers, and the public-at-large.

The IPA has a demonstrated track record of contributing to, and changing the terms of the public policy debate in Australia and internationally. In particular, in recent years the IPA has been at the centre of public discussion in Australia and in appropriate international fora on:

- Regulation
- Trade
- Intellectual property
- Water
- Energy
- Housing
- Industrial relations
- Taxation
- Investment

9.0 About the author | Tim Wilson

Tim is a trained carbon accountant and currently Director of Climate Change Policy at the Institute of Public Affairs – the world's oldest free market think tank.

Tim also serves on the Department of Foreign Affairs and Trade’s IP industry consultative group, as a Senior Fellow at New York's Center for Medicine in the Public Interest and as a Director of the Alfred Health Board covering the Alfred, Caulfield, and Sandringham hospitals in south-east Melbourne.

He regularly appears on Australian and international television, radio, and in print media, and he previously co-hosted ABC News 24 TV’s *Snapshot* segment.

He’s worked in international development across South-East Asia, consulting, and politics, including delivering Australia's aid program for the Vietnamese government to host APEC, and advising state and federal politicians.

In 2009 *The Australian* newspaper recognised him as one of the ten emerging leaders of Australian society and he is a recipient of an Australian Leadership Award from the Australian Davos Connection.

At University Tim was twice elected President of the Student Union as well as to the University’s Board of Directors.

Tim is currently completing a Graduate Diploma of Energy and the Environment (Climate Science and Global Warming) at Perth’s Murdoch University.

He has a Masters of Diplomacy and Trade and a Bachelor of Arts from Monash University, a Diploma of Business and he has completed Asialink’s Leaders Program at the University of Melbourne. He has also completed specialist executive education on IP at the WIPO Worldwide Academy and international trade and global health diplomacy at the Institut de Hautes Études Internationales et du Développment, Geneva.