ACT Greenhouse Gas Inventory for 2015-16: with recalculations for 2014-15

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1. Introduction

This report presents the ACT Greenhouse Gas Inventory for 2015-16. This inventory has been developed on the basis of the latest methodology, approved and published in July 2016

This methodology incorporates all the changes arising from the methodology review initiated in 2015 and completed in 2016. At the time the 2014-15 inventory was compiled, not all of these changes were in place. The inventory for that year was therefore provisional. Hence, as foreshadowed in the 2015 *Inventory Report*, this report includes recalculations of the 2014-15 emissions inventory. The 2014-15 inventory can now be considered as Final, though it will of course be subject to any recalculations necessitated by future changes to the national emissions inventory methodology.

As explained in the 2015 *Inventory Report*, the most important changes rising from the methodology review are those relating to emissions associated with the consumption of electricity; these changes were incorporated in the 2014-15 inventory. The emission source categories most affected by the changes incorporated in the 2015-16 inventory are Waste and Land Use, Land Use Change and Forestry (LULUCF). Much smaller changes affect Agriculture and Industrial Processes.

In the case of LULUCF, the methodology review recommended, in effect, continuation of the previous approach of using the published National Greenhouse Gas Inventory figures for the ACT, with a two year lag resulting from the timing of publication of the National Inventory. The reason for the major change in ACT emissions contained in this *Inventory Report* is the large changes made to the national calculations between 2012-13 and 2013-14, not the application of these to the ACT *per se*.

In the case of Waste, the methodology review in 2014-15 recommended moving away from the use of source published National Greenhouse Gas Inventory figures for the ACT, because these are not based on ACT-specific data, but use national data, pro-rated to states and territories in proportion to population. Two separate inventories were compiled in 2014-15: the second inventory version included use of the new methodology for Waste, because it provided the Directorate with a more reliable estimate of actual ACT emissions, even though the new methodology had not been formally adopted at that time. The new inventory was formally approved for use in July 2016, and is used completely in this inventory for the first time. There have been some further modest changes to the calculation since its use for indicative purposes in 2015. In addition, this Inventory Report uses the IPCC 2006 Global Warming Potential (GWP) values for the first time. For the ACT, this change has a negligible impact, except for Waste, where changing the GWP of methane from 21 to 25 increases emissions measured in terms of CO_2-e by 19 per cent. The result of these changes is a relatively large increase in estimated emissions from Waste.

2. Total ACT Greenhouse Gas Emissions

The estimate of total greenhouse gas emissions for the ACT in 2015-16 is 4,040 kt CO_2-e.

This total includes the net impact of both emissions and removals of CO_2-e in the land use, land use changes and forestry (LULUCF) sector, which is estimated to be a small net CO_2 sink in the ACT.

Table 1 shows the results for 2015-16, and the recalculated results for 2012-13, 2013-14 and 2014-15, together with the recalculated estimate for the reference year of 1989-90. The targeted result for 2020 is also shown. This target is 40 per cent below the 1989-90 level of greenhouse gas emissions and is a legislated objective. It can be seen that emissions in 2015-16 were 26 per cent higher than in 1989-90 and 1 per cent higher than in 2014-15.

Table 1 - Total ACT Greenhouse Gas Emissions Summary (kilo tonnes CO_2-e)

	1989–90	2012–13	2013–14	2014–15	2015-16	2020 Target
Current	3196.8	3,949.0	3,839.8	3,997.7	4,039.7	1,918
Previous (provisional)	3,185.5	3,869.2	3,759.8	3,934.0	NA	1,911

Table 2 shows per capita emissions for the same years as reported in the previous table. It can be seen that per capita emissions rose between 2013-14 and 2014-15 but fell slightly in 2015-16, as population growth outpaced the modest increase in emissions. Factors contributing to the change in emissions in 2015-16 are discussed later in this report.

Table 2 – ACT Population, Total Greenhouse Emissions (kt CO_2-e) and Emissions per Capita (t CO2-e)

Year	1989–90	2012–13	2013–14	2014-15	2015-16
Population (at 31 December)	279,219	377,927	383,310	387,866	393,107
Emissions (kt CO2-e)	3196.8	3,949.0	3,839.8	3,997.7	4,039.7
Emissions per capita (t CO2-e)	11.45	10.45	10.00	10.31	10.27

3. Emissions by source

Stationary energy is the dominant source of emissions in the ACT. In 2015-16, as in all previous years, it produced over two-thirds of the CO_2-e emissions that were attributable to the ACT.

The transport sector is also very important, with one-quarter of emissions coming from petroleum based fuels used in transport vehicles. Industrial processes, waste, and fugitive emissions related to the energy sector account for most of the remainder of emissions. The net effect of land use, land use changes and forestry (LULUCF) in the 2015-16 emissions inventory was a reduction in emissions of 7.9 kt CO_2-e. Table 3 provides the broad breakdown of ACT emissions for the year 2015-16.

Table 3 - ACT Greenhouse emissions 2015-16 - by source

Emissions Source	Emissions in 2015-16,kilo tonnes CO_2-e	% of total emissions ex LULUCF
Stationary energy	2,595	64.1%
Transport	1,097	27.1%
Fugitive emissions	26	0.6%
Industrial processes (synthetic gases)	205	5.1%
Agriculture	18	0.4%
Waste	106	2.6%
Sub Total (ex LULUCF)	4,047	100%
LULUCF	- 8	-0.2%
TOTAL including LULUCF	4,040	

Emissions relating to some form of energy use accounted for 92 per cent of emissions in 2015-16. This is the combined emissions of stationary energy, energy for transport, and fugitive emissions (which in the case of the ACT is the leakage of natural gas from the distribution system). Stationary energy emissions are predominantly attributable to the generation of electricity used in the ACT, though emitted elsewhere, and also include emissions from use of natural gas, non-transport use of petroleum fuels, including LPG, heating oil and fuel oil, and use of fuel wood. Emissions attributed to non-transport petroleum fuels and fuel wood are very small.

However, it should be noted that reported emissions from non-transport use of petroleum fuels are incomplete, in that they do not include emissions from the use of LPG in non-transport applications. For a variety of reasons, a number of residential and business consumers in the ACT use LPG instead of pipeline natural gas. At least three companies (Elgas, Origin and Supagas) deliver LPG in the form of both bulk refills of fixed tanks and replacement of empty cylinders with refills. No data are currently available on non-transport use of LPG, by businesses and households. Data on emissions from use of heavy fuel oil includes only the emissions reported by ICON Water, relating to use at the Lower Molonglo Water Quality Control Centre. It is unclear whether the current Fuel Survey completely captures data on diesel fuel used in off-road activities such as earth moving, forestry and agriculture. It is possible also that some on-road diesel use by businesses which operate vehicle fleets refuelled from their own bulk fuel tanks is not captured. Inclusion of additional emissions from these uses of petroleum would result in a small increase in the ACT's reported emissions.

The detail of all emissions sources for 2015-16, including changes in land use, land use changes and forestry, is shown in Table 4 below.

Table 4 - Detailed ACT Emissions Sources 2014-15

Emissions Source			kt CO_2-e
Energy			**3,719**
	A. *Fuel combustion activities*		*3,692.8*
		Electricity	2,234
		Natural gas	357.9
		Transport fuels	1,097.4
		Fuel oil	3.0
		Fuel wood	0.3
	B. *Fugitive emissions from fuels*		*26.2*
		Natural gas leakage	26.2
Industrial processes			**204.5**
		Consumption of halocarbons and SF6	204.5
Agriculture			**18.2**
		Enteric fermentation	16.1
		Manure management	0.0
		Agricultural soils	2.2
Land use, land-use change and forestry			**- 7.9**
		Afforestation and reforestation	- 3.6
		Deforestation	8.0
		Forest management	- 8.9
		Cropland management	0.02
		Grazing land management	- 3.4
Waste			**105.8**
		Solid Waste Disposal on Land	94.8
		Wastewater Handling	11.0
Total emissions including net CO_2-e from LULUCF			**4,039.7**
Total emissions excluding net CO_2-e from LULUCF			**4,047.6**

4. Changes in Greenhouse Gas Emissions between 2014-15 and 2015-16

4.1 Electricity

Emissions from electricity decreased from 2,236 kt CO_2-e in 2014-15 to 2,234 kt CO_2-e in 2015-16, a decrease of 0.1 per cent. Several factors interacted to produce this outcome.

1) Consumer demand for electricity supplied through the meter increased by 0.7% and distribution losses within the ActewAGL Distribution's network also appear to have increased. It is likely that this was driven by both population growth and the shift from gas to electricity in residential consumption. Dramatic changes in the energy efficiency of small (residential scale) reverse cycle conditioners have seen them become widely preferred to gas for whole of house space heating in all types of new houses. It is unlikely that seasonal weather differences contributed to the demand increase, as consumption of natural gas decreased.
2) The renewable electricity share of total electricity supplied increased from 18.8% to 20.2%. Of the main sources of renewable electricity supply, LRET generation, the ACT share of below baseline NSW renewable generation, and PV generation within the ACT, and output from new renewable generators directly contracted by the ACT government all increased. Purchases of GreenPower were the only source of renewable electricity supply which decreased. The overall effect was a decrease in the emissions intensity of electricity supplied to the ACT, which more than offset the small increase in consumer demand for electricity.
3) The emissions intensity of the remaining 80% of electricity, sourced from fossil fuel generators supplying the NSW region pool, increased slightly, as the share of net imports from the less emissions intensive Queensland pool declined.

Note that the quantity of below baseline NSW renewable (hydro) generation allocated to the ACT is calculated in accordance with the formally approved methodology. This is based on the total quantity of below-baseline hydro generation in the relevant inventory year. This quantity can change quite markedly from year to year, depending on annual rainfall and other factors. For example, the quantity increased sharply from 2014-15 to 2015-16, because during 2014-15 Snowy Hydro reduced output in order to allow storages to replenish, following the "over-generation" during the carbon price years. Because of this year to year variation, progress towards the ACT's renewable electricity target is calculated by using a 5 year rolling average of below-baseline hydro generation. Using this approach for the 2015-16 would have the effect of increasing electricity related emissions by 14 kt CO_2-e, which equates to 0.35 per cent. The renewable share of electricity supplied to the ACT would fall from 20.2% to 19.7%.

4.2 Natural gas

Emissions from natural gas decreased by nearly 5 per cent between 2014-15 and 2015-16, largely, though not completely, reversing the large increase between 2013-14 and 2014-15. The absolute decrease was 18 kt CO_2-e. As speculated above, this decrease may reflect a shift from gas to electricity on the part of residential consumers, but more time will be needed before this hypothesis can be confirmed, or otherwise. As noted, differences in weather are unlikely to have caused the reduction in gas consumption, and emissions.

4.3 Transport

Transport emissions increased by 44 kt CO_2-e, equivalent to 4.8 per cent, between 2014-15 and 2015-16, and were the source of by far the largest emissions increase over this period. Consumption of both petrol (auto gasoline) and diesel increased. Following changes to the coverage of the Fuel Use Survey in 2014-15, it is now highly likely that virtually all emissions arising from sales of petroleum products for transport use have been included in the inventory in both 2014-15 and 2015-16.

4.4 Fugitive energy

Data provided by ActewAGL Distribution show that from 2014-15 to 2015-16 total gas sales and throughput decreased, as noted above. However, the proportion of gas lost in the distribution network increased slightly and, as a result, the quantity of Unaccounted-for-Gas also rose slightly. Estimated fugitive emissions therefore also increased.

4.5 Waste

Emissions from waste increased by 13.6 kt CO_2-e from 2014-15 to 2015-16, equivalent to 15 per cent. Virtually all of the increase was caused by a rise in estimated emissions from solid waste disposal. The great majority of emissions from solid waste disposed at landfill sites, the predominant mode of disposal in the ACT, are contributed by so-called legacy emissions. These are emissions arising from the anaerobic breakdown of putrescible waste sent to landfill in past years. Gross emissions are partly offset by the capture of landfill gas and its combustion to generate electricity. The volumes and methane content of landfill gas captured by the two landfill gas generators, at Mugga Lane and Belconnen, were provided by the plant operators, Energy Developments Limited. There was no significant change in emissions of nitrous oxide at the Lower Molonglo Water Quality Control Centre, as advised by Icon Water.

As noted in the 2014-15 inventory report, modelled total emissions show a generally steady increase year by year, as the total volume of putrescibles waste increases at a faster rate than legacy waste completely decays away. The volume of landfill gas captured varies somewhat from year to year, and appears to have decreased somewhat in 2015-16. Various factors can affect capture volumes, including accumulation of groundwater in the lower levels of the landfill; this may be accelerated by above average rainfall. Because of the complexities of the methanogenic processes, it is difficult to provide a more complete explanation of the increase in estimated emissions between 2014-15 and 2015-16.

Note that adoption in this inventory of the new, higher Global Warming Potential value for methane, as explained earlier in this report, necessitated a recalculation of estimated waste emissions in prior inventory years. Changing the Global Warming Potential (GWP) for methane increases emissions, reported as CO_2-e, 19 per cent for a given volume of methane. Emissions for 2015-16 reported here are therefore very much higher than the 2014-15 emissions, as reported in last year's inventory report, because of the combined effects of both the higher GWP value and the underlying increase in methane emissions.

4.6 Industrial processes

ACT industrial process emissions arise entirely from loss to the atmosphere of synthetic fluorinated hydrocarbon gases, most of which are used as refrigerant gases in refrigerators, freezers and air conditioners. This emissions inventory uses the Methodology approved in July 2016. The Methodology uses the National Inventory estimates for the ACT, which are derived from a detailed model of the various categories of refrigeration equipment, developed by the Department of the Environment and Energy. Over the whole period covered, starting in 2000, the results for the ACT are an exceedingly close fit to a straight line. The approved Methodology therefore uses linear extrapolation of the estimates from 2000-01 to 2013-14 (the most recent National Inventory figure) to estimate emission in 2014-15 and 2014-16. The result is a small increase in the estimate for 2014-15, as reported in last year's report, and quite a large increase from 2014-15 to 2015-16. As explained in last year's report, the increase arises from the continuing progressive replacement of Montreal Protocol refrigerant gases by hydrofluorocarbon gases covered by the UNFCCC. Relevant staff in the Department of the Environment and Energy have confirmed the advice provided last year, that they expect this trend to continue for several more years.

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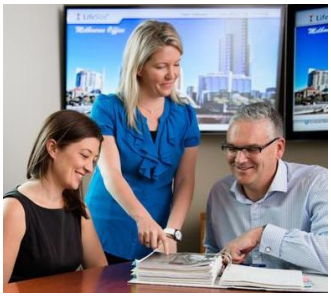


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