



Is CO₂ mitigation cost-effective?

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This summary updates Monckton of Brenchley (2013), read at the World Federation of Scientists' 2012 Seminars on Planetary Emergencies. For the first time, the paper combined mainstream IPCC climatology and inter-temporal investment appraisal. The cost of Australia's CO₂ tax (Parliament of Australia, 2011) over its ten-year term was compared with the benefit in the cost of warming-related damage avoided by the tax.

Discount rate: The minimum market discount rate is 5% (Murphy *et al.*, 2008), but the rate assumed here is **0%**.

Fraction of world CO₂ emissions abated: Over ten years, the tax, which its inventor, Professor Garnaut, said in 2013 had failed, cannot now abate more than **5%** of predicted CO₂ emissions. Australia emits **1.2%** of world emissions (derived from Boden *et al.*, 2010ab). The tax will thus abate **5% x 1.2% = 0.06%** of world emissions.

CO₂ concentration abated: Without the tax, CO₂ concentration after ten years would be **410 μatm** (IPCC, 2007), up by **20 μatm** on the **390 μatm** (Conway & Tans, 2011) at the outset. With the tax, after ten years CO₂ concentration would be **410 μatm** less **0.06%** of the 20 μatm growth: i.e. **409.988 μatm**.

CO₂ forcing abated (IPCC, 2007; Myhre, 1998), would be **5.35 ln(410/409.988) = 0.00016 W m⁻²**.

A climate sensitivity parameter is multiplied by this forcing to determine warming over the ten-year term. Garnaut (2008) talks of keeping greenhouse-gas rises to **730 μatm** CO₂-equivalent, **450 μatm** above the **280 μatm** (IPCC, 2007) prevalent in 1750, to hold 21st-century warming since then to **2 C°**. His implicit 100-year sensitivity parameter, in line with IPCC's implicit **0.44 C° W⁻¹ m²**, is thus **2 C° / [5.35 ln(730/280) W m⁻²]**, or **0.39 C° W⁻¹ m²**, up by **0.08 C° W⁻¹ m²** on the instantaneous (Planck) parameter **0.31 C° W⁻¹ m²** (IPCC, 2007, p. 631 fn). Thus a reasonable ten-year parameter is **0.31 + 10/100(0.08) = 0.32-0.33 C° W⁻¹ m²**.

Global warming abated by the tax – the ten-year parameter multiplied by the forcing abated – would be **0.33(0.00016) = 0.00005 C°**, or **1/20,000 C°**.

Measuring performance: Even if the tax succeeded, we could not detect that it had. **1/20,000 C°**, as a fraction of the **0.05 C°** measurement uncertainty in temperature datasets, is just **1/1000** of that uncertainty.

The cost of the tax: The tax, as enacted in Australia's Clean Energy Act 2011, is costing **\$10.1 bn/year**, plus **\$1.6 bn/year** for administration (Wong, 2010, p. 5), plus **\$1.3 bn/year** for renewables and other costs, a total of **\$13 bn/year**, escalated under the Act at **2%/year**, and by a further **2%/year** to allow for economic growth. Conservatively, the total cost over the ten-year term will thus be **\$162.3 bn**.

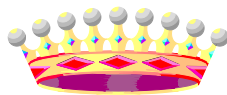
Mitigation cost-effectiveness of the tax, which is the cost of abating **1 C°** warming by global measures as cost-effective as the tax, is **\$162.3 bn / 0.00005 C° = \$3.2 quadrillion per C° abated**.

Projected anthropogenic warming over the ten-year term will be **0.17 C°** (IPCC 2007, p. 803, Table 10.2).

The cost of abating **0.17 C°** warming by global measures as cost-effective as the tax is **0.17 x \$3.2 quadrillion**, or **\$540 trillion** in cash, which, divided by global population of **7 bn**, is **\$77,000 per capita**. Divided by ten years' global GDP of **\$670 trillion** (derived from World Bank, 2011), it is equivalent to **80% of global GDP**.

The benefit: Stern (2006, p. vi), estimates that the avoided-cost benefit of abating the **3 C°** 21st-century global warming expected by the IPCC will be **0-3%** of 21st-century global GDP. Since warming of **0.14 C°/decade** observed in the 23 years since 1990 (HadCRUt3gl, 2011) is less than half the IPCC's **3 C°/decade** central estimate, a fair avoided-cost benefit is **1.5% of GDP**.

Cost-benefit ratio: The cost of immediate mitigation divided by that of later adaptation is **80% / 1.5%**, or **53**. It is at least **50 times** more expensive and less cost-effective to mitigate CO₂ emissions by typical measures such as Australia's carbon tax than to take no action at all today and, instead, to meet the later and far lesser cost of climate-related damage arising from unabated global warming of **3 C°** the day after tomorrow.



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