

ATTACHMENT D – Explanatory Note

CO₂ REDUCTIONS FROM 100 BCM OF SHALE GAS USED TO DISPLACE COAL-FIRED POWER GENERATION

See discussion in text at Section 4D.

Note: All conversion and emissions factors from U.S. EPA, Unit Conversions, Emissions Factors and Other Reference Data (November 2004),
<http://www.epa.gov/appdstar/pdf/brochure.pdf>

1. Convert 100 bcm to cubic feet:

$$1.0 \times 10^{11} \text{ m}^3 \text{ nat gas} \times \frac{35.315 \text{ ft}^3}{1 \text{ m}^3} = 3.5315 \times 10^{12} \text{ ft}^3 \text{ nat gas} \quad (= 3.5315 \text{ Tcf nat gas})$$

2. Calculate energy content of that gas:

$$3.5315 \times 10^{12} \text{ ft}^3 \text{ nat gas} \times \frac{1.027 \times 10^3 \text{ btu}}{1 \text{ ft}^3 \text{ nat gas}} = 3.626851 \times 10^{15} \text{ btu}$$

3. Assume 60% efficient combined cycle gas turbine:

$$3.626851 \times 10^{15} \text{ btu} \times 60\% = 2.176111 \times 10^{15} \text{ btu}$$

4. Calculate amount of coal required to generate that much energy, assuming a 40% efficient supercritical coal plant:

$$\frac{2.176111 \times 10^{15} \text{ btu}}{2.493 \times 10^7 \text{ btu/ton coal} \times 40\%} = 2.1822 \times 10^8 \text{ tons of coal}$$

5. Calculate CO₂ emissions from that amount of coal:

$$2.1822 \times 10^8 \text{ tons of coal} \times \frac{5.086 \times 10^3 \text{ lb CO}_2}{\text{ton coal}} = 11.0988 \times 10^{11} \text{ lb CO}_2$$

6. Convert to metric tons

$$11.0988 \times 10^{11} \text{ lb CO}_2 \times \frac{4.5359 \times 10^{-4} \text{ metric tons}}{1 \text{ lb}} = 50.34 \times 10^7 \text{ metric tons} = 503.4 \text{ MMT}$$

7. Calculate CO₂ emissions from 100 bcm of natural gas

$$100 \text{ bcm nat gas} = 3.5315 \times 10^{12} \text{ ft}^3 \text{ nat gas} \times \frac{0.12 \text{ lb CO}_2}{1 \text{ ft}^3 \text{ nat gas}} = 4.2378 \times 10^{11} \text{ lb CO}_2$$

8. Convert to metric tons

$$0.42378 \times 10^{12} \text{ lb } CO_2 \times \frac{4.5359 \times 10^{-4} \text{ metric tons}}{1 \text{ lb}} = 1.922 \times 10^8 \text{ metric tons} = 192.2 \text{ MMT}$$

9. Subtract natural gas emissions from coal emissions

$$503.4 \text{ MMT} - 192.2 \text{ MMT} = \mathbf{311.2 \text{ MMT avoided emissions}}$$