Assessment Programme (AMAP) report on The Impacts of Black Carbon on the Arctic Climate, the International Global Atmospheric Chemistry (IGAC) and Stratospheric Processes And their Role in Climate (SPARC) Atmospheric Chemistry and Climate (AC&C) Activity, the US Environmental Protection Agency (EPA) Black Carbon Report to Congress, the EU Atmospheric Composition Change the European NeTwork Plus (ACCENT Plus), and the Long Range Transboundary Air Pollution (LRTAP) and European Monitoring and Evaluation Programme (EMEP) Task Force on Hemispheric Transport of Air Pollution (HTAP). By building upon these current efforts, the Air Pollution & Climate Initiative frames the Air Pollution and Climate Change Challenge as a problem comprising one atmosphere, same pollutants, and multiple effects.

Over the next two years, the Air Pollution & Climate Initiative will produce two documents:

1. IGBP Statement on the Air Pollution and Climate Change Opportunity
2. Strategic Plan for a Multi-Disciplinary Program on Air Pollution & Climate Change

The IGBP Statement on the Air Pollution and Climate Change Opportunity will provide a concise assessment of the benefits and risks associated with mitigating air pollutants for human health, agriculture, ecosystems, and climate. The statement will be released as a briefing document at the ICSU Planet Under Pressure Conference March 2012 in London.

At the same time the Air Pollution & Climate Initiative will develop and publish a strategic plan for a multi-disciplinary program on Air Pollution and Climate Change that will engage the international earth system science, social science, and policy communities. This will build on and take account of other international efforts coupling air quality and climate research such as the ICSU-Belmont Earth System Visioning process and provide specific recommendations and methodologies for creating and sustaining such a multi-disciplinary international program.

A follow up workshop on the IGBP Air Pollution & Climate Initiative is scheduled to take place 7-10 November 2011 in Taipei, Taiwan. This workshop will focus on Air Pollution & Climate: A Science-Policy Dialogue in Asia. The Taiwan Environmental Protection Agency (EPA) is sponsoring the workshop.

For more information visit http://www.igbp.net/4.1b8ae20512db692f2a6800018410.html

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## Methane Mitigation – Benefits for air quality, health, crop yields, and climate

Air Pollution & CLIMATE a science-policy dialogue

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Air pollution contributes to climate change and climate change will likely exacerbate air pollution in some regions of the world, even if emissions of reactive air pollutants remain constant. As a result, there is an increasing dialogue between the scientific and regulatory communities to coordinate efforts to reduce emissions of reactive air pollutants, greenhouse gases and fine particulates and their precursors so that controls are beneficial for both air quality and climate. The newly launched IGBP Air Pollution & Climate Initiative is intended to facilitate such discussions and coordination.

Mitigation of methane ($CH_4$) emissions provides an opportunity to simultaneously improve air quality and reduce the rate of climate change. In addition, $CH_4$ is the primary constituent of natural gas and an important energy source. As a result, efforts to prevent emissions or capture and use CH4 offer significant environmental, energy and economic benefits [*USEPA*, 2006].

At approximately 1.8 ppm, $CH_4$ is the most abundant non-carbon dioxide ($CO_2$) greenhouse gas (GHG) in the atmosphere today [*Montzka et al.*, 2011]. $CH_4$ accounts for approximately 15% of current radiative forcing from GHGs in the atmosphere and comprises 63 percent of annual $CO_2$eq (equivalent $CO_2$ emissions calculated using a 100-year time horizon global warming potential, $GWP_{100}$) emissions of non-$CO_2$ GHG [*WWS*, 2011]. Methane is also a precursor of tropospheric ozone ($O_3$) and contributes to the growing global background concentrations of tropospheric $O_3$, itself a GHG and air pollutant with detrimental impacts on human health and vegetation. A strong positive feedback on radiative forcing (RF) through atmospheric chemistry is found following increased emissions of methane [*Isaksen et al.*, 2011]. This occurs because methane is a GHG, the $O_3$ it produces is a GHG, and increased $CH_4$ concentrations depress concentrations of the hydroxyl radical (OH), the primary sink of methane, which thus increases the lifetime of methane. In addition, methane oxidation produces $CO_2$ and leads to increased stratospheric water vapor, which contributes to destruction of stratospheric $O_3$ and to surface warming [*Shindell*, 2001].

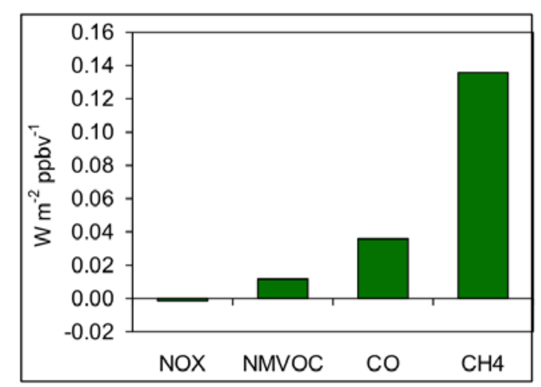


**Figure 1.** A 20% global reduction in anthropogenic emissions of $NO_x$, NMVOC, CO and $CH_4$ results in varying radiative forcing decreases per unit decrease in global surface $O_3$ concentration ($Wm^{-2}ppbv^{-1}$). Methane emission reductions result in the largest decrease in RF per unit decrease in surface O3 concentration of any O3 precursor. Results are from global model calculations discussed in *West et al.* (2007) as presented in *Jacob et al.* (2011).

$O_3$ is produced via the catalytic reaction of nitrogen oxides ($NO_x$=NO+$NO_2$) with non-methane volatile organic compounds (NMVOCs), carbon monoxide (CO) or $CH_4$ in the presence of sunlight. The effect of $O_3$ precursor emission reductions on RF per unit reduction of surface $O_3$ concentrations vary. Shown in Figure 1 is the calculated decrease in RF per unit (part per billion by volume, ppbv) decrease in global surface $O_3$ concentrations resulting from a 20% global decrease in anthropogenic emissions of each of the key $O_3$ precursors: $NO_x$, NMVOC, CO and $CH_4$. Of all $O_3$ precursors, $CH_4$ emission reductions result in the largest decrease in RF per unit reduction in surface $O_3$ [*West et al.*, 2007]. Thus, of all $O_3$ abatement strategies, methane controls reduce the rate of climate warming most.

Model simulations indicate that had global anthropogenic methane emissions been reduced by 20% beginning in 2010 the average daily maximum 8-h surface ozone would decrease by approximately 1 ppbv globally [*West et al.*, 2006]. By using epidemiologic ozone mortality relationships, this ozone reduction was projected to prevent approximately 30,000 premature all-cause mortalities globally in 2030, and 370,000 between 2010 and 2030 [*West et al.*, 2006].

Increasing evidence points to elevated $O_3$ concentrations as an important and usually overlooked stress on global crop yields [*Avnery et al.*, 2011a; *Van Dingenen et al.*, 2009; *Wang and Mauzerall*, 2004]. Recent model simulations quantified the present and potential future (year 2030) impact of surface $O_3$ on the global yields of soybean, maize, rice and wheat given both upper- and lower-boundary projections of reactive $O_3$ precursor emissions [*Avnery et al.*, 2011a; b; *Van Dingenen et al.*, 2009]. *Van Dingenen et al.*, 2009; and *Avnery et al.*, 2011b projected substantial future yield losses globally for these crops: 10-16% for soybean, 3-6% for maize, 4-6% for rice, and 4-18% for wheat, even under scenarios of stringent $O_3$ controls via traditional pollution mitigation measures (i.e. reductions in $NO_x$, CO, and NMVOCs). In addition to reductions in short-lived $O_3$ precursors, further calculations indicate that mitigation of surface $O_3$ through gradual reductions in methane emissions between 2006 and 2030 could increase global production of soybean, maize and wheat by 23-102 Mt in 2030 – the equivalent of a ~2-8% increase over year 2000 production of these crops, worth US$3.5-15 billion worldwide ($USD_{2000}$) [*Avnery et al.*, submitted 2011].

With a lifetime of about a decade and a $GWP_{100}$ of over 20, methane mitigation provides an opportunity to slow the acceleration of climate change. Because neither the air quality nor climate benefits of $CH^4$ mitigation depend strongly on the location of the $CH_4$ emission reductions, the lowest cost emission controls can be targeted [*Fiore et al.*, 2008]. Large potential for methane emission reductions exists, including the recovery of methane from coal, oil and gas extraction and transport, methane capture in waste management, and modifications of some rice cultivation and livestock management practices [*UNEP/WMO*, 2011]. Widespread implementation is achievable with existing technology but requires significant strategic investment and institutional arrangements [*UNEP/WMO*, 2011]. Many measures achieve cost savings over time, however initial capital investments are necessary in some cases. Figure 2 provides a cost curve for various methane mitigation options and indicates that at least 10% of projected 2030 methane emissions can be eliminated at a net cost saving [*ClimateWorks*, 2011].

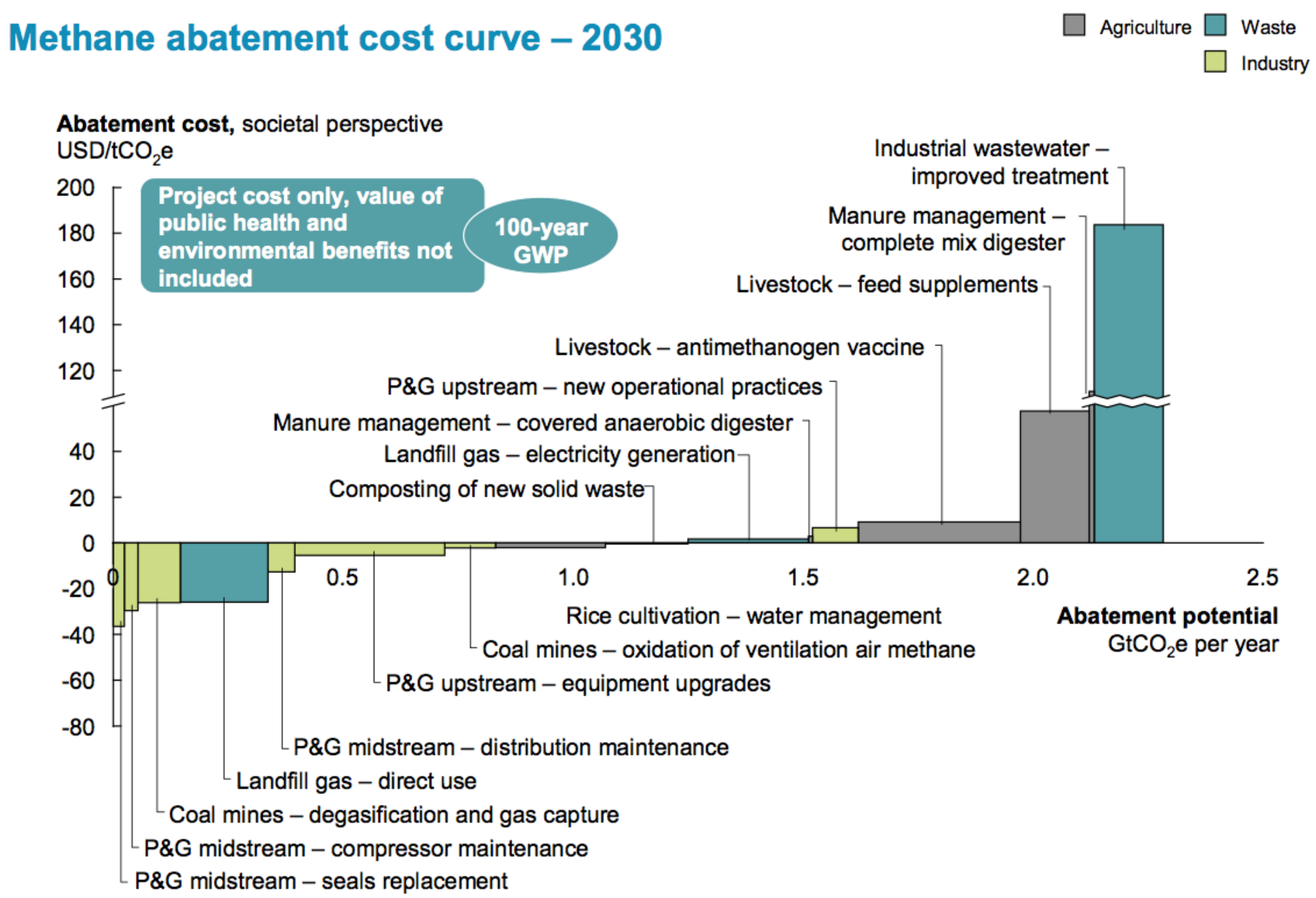


**Figure 2.** Global methane abatement cost curve. According to these estimates, methane mitigation of over 1.0 Gt $CO2_{eq}$ (approximately 10% of business-as-usual $CH_4$ emissions in 2030) can be achieved at a net cost savings. P&G = Petroleum and Gas [*ClimateWorks*, 2011].

Given the challenges of successfully implementing these mitigation strategies globally, further research which spans the scientific and stakeholder communities is needed to optimize near-term mitigation strategies in countries around the world and to evaluate the cost-benefit ratio for individual measures. This is an area where the newly launched IGBP Air Pollution & Climate Initiative, whose members span the scientific and stakeholder communities and include representatives from developed and developing countries, will have an opportunity to facilitate the implementation of cost-effective methane mitigation strategies which benefit air quality, human health, agricultural yields and climate.

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