Economics of mercury control

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Published by the International Energy Agency - Clean Coal Centre
www.iea-coal.org.uk

This summary is a contribution from the International Energy Agency - Clean Coal Centre to the UNEP Global Mercury Partnership Mercury Emissions from Coal partnership area. The full document can be purchased at http://bookshop.iea-coal.org.uk/site/uk/clean-coal-technology-research-reports

Mercury in the environment has been associated with negative environmental impacts. Elevated concentrations of mercury in fish in the diet can lead to neurological problems, especially in young children. Improvements in the understanding of the mercury issue and more accurate emission inventories will identify areas of greatest emissions and therefore of greatest concern. Targeting the most polluting sources first could result in the greatest mercury reduction for the least investment. More accurate emission data will also facilitate better regulation and monitoring of the success of reduction strategies.

Coal combustion is a significant, if not the major, source of mercury emissions in many countries. Some areas in the developed world, such as the EU, have managed to reduce mercury emissions significantly (around 70% in the last three decades) due to measures taken to reduce emissions of other pollutants. These reductions are expected to continue for the next decade or so, even without mercury-specific controls, due to further co-benefit effects from existing and impending legislation. Despite an overall reduction in mercury emissions from human activities in the developed world, emissions from developing nations and emerging economies are increasing at such a rate that the overall global mercury emission trend is still upwards.

Mercury-specific legislation has been set in Canada and certain states in the USA. The US EPA is currently working to promulgate a new mercury-specific regulation to replace the recently vacated Clean Air Mercury Rule (CAMR). Despite the vacation of CAMR in the USA, which would have specifically targeted mercury, there is still an impetus for mercury control at many plants in the USA.

Control systems for, particulates, SO_2 and NOx can result in concomitant mercury reduction. Since these flue gas treatment systems are not primarily designed to reduce mercury emissions, the amount of mercury captured is variable. These systems can be adjusted to enhance mercury capture, for example by lowering temperatures in flue gas and ESP systems. However, many of these adjustments can cause detrimental effects to the operation of the control system or to areas of the plant downstream. Whole balance-of-plant effects must be taken into account and this must be done on a unit-by-unit, coal-by-coal basis *(see Figure1)*. By enhancing co-benefit/baseline mercury capture in a plant, the requirement for additional, more costly, methods of mercury control can be reduced.

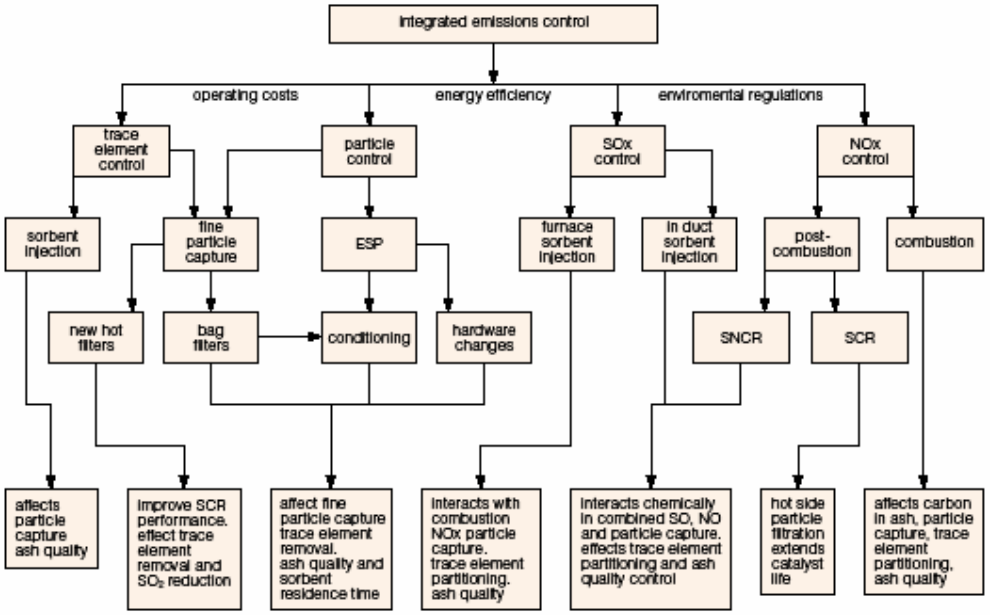
For many plants the amount of mercury reduction achievable through co-benefit effects may not be enough to meet current or future legislative demands. In these cases, more costly mercury specific control techniques and technologies are required. These include techniques such as activated carbons or sorbent injection, oxidation methods and electrochemical methods. For the most part, these technologies have an equal chance to find a niche in the

market, although early demonstrations may prove more effective. At the moment, it is commonly assumed that there is no single BAT/MACT (best available technology/maximum achievable control technology) for mercury on coal-fired plants. Should the new US EPA CAMR-replacement result in a requirement for MACT then the US EPA will face a challenge to select the most appropriate technologies and the market could change dramatically.

Estimating the cost of control technologies for coal-fired plant is problematic since much of the current data are based on either pilot-scale studies or short-term full-scale studies. Further, the variation in mercury behaviour at different plants makes it difficult to make generalised assumptions for cost analyses. As the market for mercury control technologies develops further, prices are likely to drop quite dramatically. Market forces will determine which control technologies will become the most popular, with early successful demonstrations having the most opportunity to take a larger portion of the marketplace.

On a national/international scale, there will be costs associated with establishing relevant legislation and ensuring the legislation is applied. On a global scale, any action taken to curb mercury emissions is likely to be far more effective if funding is made available to ensure that developing countries and economies in transition can afford to adopt the most appropriate strategies or technologies. In order to ensure that mercury emissions are reduced not only in the developed world, but also in those countries where emissions are increasing, co-benefit approaches may be the most economically sound approach. In order to maximise this, the transfer of information and expertise, if not technologies themselves, would go a long way to reducing mercury emissions in an economic manner. Economic measures such as technology transfer, reduced loan rates, preferential energy tariffs and modified emission fines could be promoted.

International action, such as that on-going through the UN Environment Programme, could provide the impetus for action sooner rather than later and could also assist in the provision of economic resources to ensure compliance. The lessons learned from the development of more costly mercury-specific control technologies in North America could be passed on in the longer-term when the marketplace is established and the costs of these systems have come down. It is in this area that the UNEP Mercury Partnership areas could make a significant contribution to the improvement in emission inventories and the alignment of reduction strategies worldwide.



Balance of plant considerations for emission control systems