Abstracts

SESSION 5 – Global Climate Change/Emission Measurement

Chair: **James Eberhardt, U.S. Department of Energy**

There is no Silver Bullet: Regionalization and Market Fragmentation in Greenhouse Gas Mitigation Strategies

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Over the past decade investigations into the options available to nations for mitigating greenhouse gas emissions and stabilizing their concentrations in accordance with the UN Framework Convention on Climate Change have begun to paint an increasingly sophisticated picture of how the future might evolve. This picture is becoming richer, both in technological detail with regards to the differing portfolio demands of regions across the world, and in the nature and timing of the markets that may emerge in a carbon constrained world. From a regional perspective, availability of energy resources, land, and geologic sequestration capacity are beginning to be understood as key factors that will shape the evolution of national and regional energy systems as well as climate/energy policy for these regions. For example, regional insolation and competition for land with food production will create differing biofuel prices and opportunities. Markets too are beginning to exhibit interesting differences. For example, while gasoline, Diesel, and jet fuel serve different end-uses in the current economy, the fact that they are petroleum distillates hides some of the differences in the associated markets. As we examine these markets and the future energy demands it appears for example that multiple "advanced conventional transportation technologies" (e.g., hybrids, bioethanol, Diesel, biodiesel) can and likely will persist in the market for many decades. Near term penetration of these technologies depends on the availability of compatible vehicles. In the long run, these technologies will be controlled by resource availability, for example, biofuels dependence on land availability.

Pollutants Emissions, Global Warming Potential Effect, First Comparison using External Costs on Urban Buses

Gabriel Plassat
French Agency for Environment and Energy Management (ADEME)

In 1999, ADEME started a national program relating to a comprehensive study on urban transports. Several technical solutions were evaluated to quantify on a real driving condition for buses, on one hand pollutant emissions and fuel consumption and on the other hand reliability and cost in a real existing fleet.

There are two different action types:

- The pollution caused by the existing fleet can be reduced by using fuel modifications, Diesel particulate filters (DPF) and/or nitrogen oxides (NO_X) reduction systems. The following technologies were evaluated: Diesel with low sulfur content, Diesel with water emulsion, Diesel with biofuel content, five different DPF's, and an exhaust gas recirculation system were tested (an estimation of NO_X reduction was done).
- When renovating a fleet and opting for vehicles whose emissions are lower than Diesel, new measures can be adopted. By using natural gas vehicles (stoechiometric and lean combustion solutions with Euro II engines), liquid petroleum gas, hybrid buses, or of electric buses.

First, representative driving cycles for buses were established by ADEME and industrial partners. Using these cycles, pollutants were measured as well as fuel consumption, at the beginning of the program and one year after to quantify reliability and measure the increase/decrease of pollutant emissions. Coincidently, under real conditions, each technology was tested on bus fleets in city use. Information (such as fuel consumption, lubricant analysis, problems with the technology) was followed during the one year program.

This paper presents results obtained from testing these urban buses. For these vehicles, the same test procedure was used, to set up clear comparison between these technologies. An external cost comparison was done using European Cleaner Drive methodology and results are presented.

Impact of Clean Diesel Technology on Climate Change

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Brookhaven National Laboratory

The lifetime and radiative properties of black carbon (BC) in the atmosphere are thought to depend strongly on the extent of the mixing of these particles with sulfate. Such mixing controls the transformation rate between hydrophobic and hydrophilic BC, hence atmospheric lifetime, and the extent to which BC aerosols become coated by sulfate, hence BC optical (radiative) properties. In this talk we will summarize progress and plans to carry out atmospheric simulations using regional-to-hemispheric scale chemical transport models. These models now fully include atmospheric sulfate processes and will soon include the latest inventories for Diesel BC emissions, including the projected emissions reduction achievable through clean Diesel technology. These inventories will be used to evaluate the relative importance of Diesel as a BC source in comparison with other sources (biomass burning, etc.). The mixing state of the aerosol will be represented using a multivariate aerosol module developed at Brookhaven for simulating the microphysical properties and dynamics of generally-mixed aerosols. Here we focus on the mixing state of BC plus sulfate taking into account both sulfate emissions (e.g. from powerplants) and BC emissions and determine if this mixing is important to aerosol optical properties and climate. When complete, the new calculations will provide an independent assessment of the importance of the Jacobson effect.

Mass Correlation of Engine Emissions with Spectral Instruments

David Kittelson, Tim Hands, Chris Nickolaus, Nick Collings,
Ville Niemelä, and Martyn Twigg

This paper presents results from a study comparing three spectral aerosol instruments (DMS500, SMPS, DMM230) that were used to make dilute Diesel emission measurements from a light duty DI engine capable of running legislated drive cycles. Transient spectral data is presented and also used to estimate particulate mass emissions. These results are compared to filter paper measurements. The correlation for untreated dilute measurements is compared to that for an aerosol sample with a catalytic stripper applied. Transient mass emissions are presented for the instruments capable of real-time measurements.

Bifunctional Catalysts for the Selective Catalytic Reduction of NO By Hydrocarbons

Christopher Marshall, Michael Neylon, Mario Castagnola, and Jeremy Kropf
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Novel bifunctional catalysts combining two active phases, typically Cu-ZSM-5 and a cerium oxide modifier were prepared and tested for the selective catalytic reduction of nitrogen oxides using hydrocarbons in order to overcome the hindering effects of water typically seen for single phase catalysts such as Cu-ZSM-5. Chemical characterization by temperature programmed reactions, DRIFTS and x-ray absorption spectroscopy indicated strong interaction between the two phases, primarily producing materials that exhibited lower reduction temperatures. Two improvements in NO_X reduction activity were seen for these catalysts compared with Cu-ZSM-5: a lower temperature of maximum NO_X conversion activity (as low at 250°C), and an enhancement of activity when water was present in the system. The use of the modifier phase provides a way to further tune the properties of the catalyst in order to achieve mechanistic conditions necessary to maximize NO_X remediation. The catalyst works best for olefin reductants but shows highly promising activity and selectivity at 350°C when JP-8 is used as a reductant. Effects on feed conditions will be discussed.

Making Mobile Measurements Using an EEPS™ Spectrometer

Tim Johnson and Rob Caldow
TSI Incorporated

Laboratory measurements of engine exhaust provide meaningful information about engine emissions, but the sampling and conditioning of the emissions affect the size distribution of the particle emissions. Roadside measurements, and increasingly on-road measurements, provide an important link to what the emissions are in the real world. On-road measurements are transient and various methods such as sampling bags have been used to obtain size distribution measurements of on road particles. The TSI Engine Exhaust Particle Sizer™ (EEPS™) spectrometer was designed primarily to measure engine exhaust emission transients in a laboratory setting. A study was done to see if the EEPS could be used in a mobile lab environment.

Vibration is a problem for many instruments in a mobile measurement environment, but is a particularly difficult one for an instrument such as the EEPS that uses electrometers that are sensitive to vibration. The electrometers are rings that surround a central high voltage rod. Vibrations in the electrometer rings or in the central rod produce currents that increase the noise in the signal. The vibration from road noise leads to increased noise in the baseline signal of the instrument. Therefore, using the EEPS in a vehicle to measure on-road exhaust emissions presents a challenge.

To determine the usefulness of the instrument for this application, a test vehicle was assembled using a Toyota Sienna minivan as a platform for on-highway chase tests. A conductive probe was mounted on the roof of the van and conductive flexible tubing brought the air sample to a flow splitter and from there to a TSI 3090 EEPS and a TSI 3022A CPC. The instruments were strapped down to the floor of the vehicle for stability during vehicle motion. No additional vibration isolation was employed. A video and still camera were used to record for correlation purposes and a laptop was used to collect data. An inverter was used to provide AC power to the instrumentation during the tests.

Baseline noise levels were measured by collecting data with a high efficiency filter in the sampling line while operating the vehicle over a bumpy road. Results showed that although the baseline RMS noise for bumpy road conditions was about 3 times higher than the bench top levels, the signal is sufficient to clearly show particle burst events from most diesel sources such as trucks, buses, and semi-trailers. The EEPS total concentration also closely matched the CPC concentrations and correlated very well with particle bursts. Therefore, based on the test results, the EEPS should prove to be a valuable tool for mobile on-road chase experiments.