Co2 And Nox Are Achieved Bhoomiltd

This dissertation, "A Study on Onshore Power for Ocean-going Vessels in Container Terminals of Hong Kong" by Hin-kwan, Chan, 陳衍君, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: Thanks to globalization, which leads to an ever increasing growth in international trade and inevitably a vast emergence in shipping activities, environmental impact is receiving increasing attention around the world. Maritime industry is under great pressure to improve its performance towards greener practices. This study attempts to provide an insight to the feasible adoption of onshore power system (OPS) for ocean-going vessels (OGVs) in the container terminals in Hong Kong. Given that OGVs are the major contributors to pollutants like carbon dioxide (CO2), sulfur oxides (SOx), nitrogen oxides (NOx), hydrocarbons (HC), carbon monoxide (CO) and various particulate matter (PM), it is of overriding importance to tackle and rectify the environmental impact of these pollutants, in particular in a densely populated port city like Hong Kong. As such, main focuses in this study laid in the environmental and financial benefits in adopting OPS technology in the container terminals in Hong Kong. Information of container vessel arrivals and engine emissions at Kwai Chung-Tsing Yi Container Terminals (KTCT) in 2011 are analyzed. By employing the energy-based approach, it is revealed that the use of OPS at KTCT could substantially reduce the CO2, SOx, NOx and PM10 levels within Hong Kong waters by 16%, 84%, 95% and 94% respectively. In addition, as far as financial benefits are concerned, this study adopted the life cycle cost analysis (LCCA), in which the capital investment cost, operational cost and maintenance cost of OPS are taken into account. Analytical data provide sound return on investment with a discounted payback period as low as 6.4 years, and up to 29% of annual energy cost saving when compared with traditional diesel powered OGVs as well. To further support the feasible implementation of OPS in Hong Kong, some real-life cases over the globe are gathered to contrast the successful adoption of OPS. Altogether with the recent compromised international standards for OPS and more stringent emission regulations enacted by International Maritime Organization (IMO), European Commission (EC) and California Air Resources Board (CARB), the commission of OPS in the container terminals in Hong Kong is just around the corner. This dissertation provides innovative management measures from an environmental perspective to promote the adoption of OPS at KTCT. Besides, incentive policy from the HKSAR Government should be expedited, stimulating the sustainable industrial practice in Hong Kong. DOI: 10.5353/thb5099110 Subjects: Air - Pollution - China - Hong Kong - Prevention Ships - Power supply - China - Hong Kong

This book presents the evolution toward advanced coal-fired power plants. Advanced power plants with an efficiency level of 45% are today commercially available and even more efficient plants are in their development phase. Considering that presently many pulverized coal-fired power plants operate with an efficiency of about 32%, an improvement of more than 40% specific coal consumption and CO2 discharge can be achieved. Before trying to apply as a secondary measure the use of carbon sequestration, it seems that this 40% specific CO2 discharge reduction as a primary measure can much easier be achieved. The effect of power generation on the environment can be drastically improved by the use of flue gas cleanup systems in advanced pulverized coal-fired power plants (SO2 emission reduction from 40 to 1.4 lb/MWh and NOx emission reduction from 7.5 to 0.64 lb/MWh). With an increased number of coal-fired plants, CO2 discharge and emissions can be reduced, even with an increase of electric power generation in the US by 38% over the next 20 years. Even though the book concentrates on pulverized coal-fired power plants, it also discusses and compares other options like fluidized-bed combustion and coal gasification.

This book focuses on the application of newly innovated analytical tools for sustainable development on regional economic and environmental issues in Korea. With a range of case studies, the authors explore a series of theoretical models and empirical methods including spatial CCE Model, multiregional Input-Output and econometric analysis, logit model, contingent valuation method, GIS, sample selection model, machine learning technique, stochastic frontier analysis, and panel analysis. These models and methods are tailored to spatial development issues such as agglomeration, clustering and industrial innovation, human capital and labor market, education and R&D investments and economic resilience for regional economies and unexpected disaster, and natural resources for environmental markets. Quantitative Regional Economic and Environmental Analysis for Sustainability in Korea is of particular interest to policy makers and practitioners, as well as research scholars active in sustainability science.

Containing papers presented at the 7th International Conference on Energy and Sustainability, this volume includes collaborative research between different disciplines, including materials, energy networks, new energy resources, storage solutions, waste to energy systems, smart grids and many other related subjects. Energy production and distribution matters as well as the need to respond to the modern world ' s dependency on conventional fuels are topics of growing importance. The use of fossil fuels has generated an increasing amount of interest in renewable energy resources and the search for maintainable energy policies. Energy policies and management are of primary importance to achieve the development of sustainability and need to be consistent with recent advances in energy production and distribution. Challenges lie as much in the conversion from renewable energies such as wind and solar to useful forms like electricity, heat and fuel at an acceptable cost (including environmental damage) as in the integration of these resources into an existing infrastructure. A range of topics are covered, including: Energy policies; Renewable energy resources; Sustainable energy production; Environmental risk management; Green buildings; Energy storage; Energy management; Biomass and biofuels; Waste to energy; Processing of oil and gas; CO2 capturing and management; Pipelines; Energy efficiency; Smart grids; Energy and transport; Case studies.

Acid Precipitation

Epa's Affordable Clean Energy Proposal

Green Aviation

Emissions Control Catalysis

Interim Report

Vol 1 - Capture and Separation of Carbon Dioxide from Combustion

IPCC Report on sources, capture, transport, and storage of CO2, for researchers, policy-makers and engineers.

Biodiesel has generated increased interest in the US and elsewhere recently as an alternative to petroleum-derived diesel. Because it can be produced from domestic feedstocks such as soybeans, canola oil, and even recycled cooking oil, biodiesel can help reduce dependence on foreign petroleum. Due to its high oxygen content, biodiesel typically burns more completely than petroleum diesel, and thus has lower emissions of hydrocarbons (HC), carbon monoxide (CO), and particulate matter (PM). However, biodiesel may increase or decrease nitrogen oxide (NOx) and carbon dioxide (CO2) emissions, depending on engine type, test cycle, and biodiesel feedstock. Therefore, the purpose of this study was to compare emissions from biodiesel blend 20% (B20) made from various feedstocks, in an on-road setting using a portable emissions measurement system (PEMS) and a chassis dynamometer setting for a test vehicle (1994 Chevy Silverado). The study tested 4 biodiesel feedstocks (soybean oil, canola oil, waste cooking oil,

and animal fat) compared with ultra low sulfur diesel (ULSD) using on-road testing under real-world driving conditions with a Horiba On-Board Measurement System OBS-1300 on a highway route and arterial route, and chassis dynamometer with Urban Dynamometer Drive Schedule. Emissions of NOx and CO2 were measured second-by-second and compared for each feedstock with ULSD. For the dynamometer only, HC, CO, and PM were also measured. Biodiesel fuel specifications from each feedstock were tested and compared. The dynamometer test results showed statistically significant lower emissions of HC, CO, and PM from all B20 blends compared to ULSD. For CO2, on-road testing (arterial, highway, and idling) and dynamometer testing showed no statistically significant difference in emissions among the B20 blends and ULSD. For NOx, dynamometer testing showed only B20 from soybean oil to have statistically significant higher emissions. This is generally consistent with the on-road testing (arterial, highway, and idling), which showed no statistically significant difference in NOx emissions between ULSD and the B20 blends. The results above are specific to the 1994 Chevy Silverado tested, and cannot be generalized to other vehicles.

Air Pollution is a significant health and environmental concern. Vehicular emissions are major contributors to many air pollution problems. There is growing interest in reducing carbon dioxide emission because of the alarming increase in the pollution caused by petroleum resulting global warming issue. Various studies have found that U.S. vehicles emit half of the CO2 emitted from vehicle all over the world. Dallas Fort Worth is a non-attainment area for ozone and it is required to achieve NAAQS standards by 2010. NOx and VOCs from the automobile are a major precursor of ozone formation in the atmosphere. Traffic signal retiming has prove to be a beneficial measure for improving traffic flow conditions and reducing fuel consumption. This research focuses on measuring CO2 and NOx from light duty vehicles to verify the effectiveness of traffic signal synchronization as measure for reduction of emissions. Data for this research were collected using the On-Board Emission Measurement System OBS-1300. The OBS-1300 facilitates real-time collection of field data for second-by-second measurement of tailpipe emissions.* (Abstract shortened by UMI.) *This dissertation is a compound document (contains both a paper copy and a CD as part of the dissertation). The CD requires the following system requirements: Micrsoft Office.

This thesis analyzes the potential for existing natural gas combined cycle (NGCC) power generation to displace coal generation thereby reducing emissions of CO2 and criteria pollutants regulated under the Clean Air Act. It also examines the potential for unused NGCC capacity to eliminate transmission congestion while simultaneously reducing CO2 and other criteria pollutant emissions. The average capacity factor of the entire natural gas fleet in year 2008 was 26%. The average capacity factor of NGCC units, a subset of the gas fleet, is 41%. NGCC units, however, are designed to operate at capacity factors as high as 85%. The delta of these two numbers has generated significant policy interest as a means for reducing C02 emissions through some type of environmental dispatch that would favor NGCC over coal generation without the need for additional capital investment. The maximum potential of natural gas power generation to displace inefficient coal generation was determined. This upper limit can provide regulators and policy makers with guideposts for further review. Various operational constraints including transmission limitations were then modeled to determine the extent to which these constraints limit fuel switching opportunities. An analysis was conducted to estimate the effects of fuel switching on transmission congestion. The conclusion of this analysis was that generation from potentially available NGCC capacity located in regions with high load centers can help alleviate the transmission congestion problem with minimal or zero capital investment for building new generation capacity. Next, an hourly dispatch model was developed that incorporates many of the complexities of the power system. This model dispatches generation from various power plants under two scenarios: a carbon unconstrained scenario (base case); and a carbon constrained scenario. Under the carbon constrained scenario, dispatch preference is give to NGCC generation over coal generation. Two regions were modeled: the Electric Reliability Council of Texas (ERCOT), which is primarily Texas; and the Florida Reliability Coordinating Council (FRCC), which is primarily Florida. Results from the two cases indicate that, without compromising system reliability: In the ERCOT region, displacing some coal generation with existing and available NGCC generation would lower CO2 emissions by nearly 22%, SO2 by 70% and NOx by 49%, compared to the base case. * In the FRCC region, displacing some coal generation with existing and available NGCC generation would lower CO2 emissions by nearly 10%, 502 by 38% and NOx by 25%, compared to the base case. The model results also indicate that for both ERCOT and FRCC, these emissions savings can be achieved with a 10% increase in electricity prices. This translates into a cost of emissions reductions of $20/ton of CO2 in ERCOT and $40/ton of CO2 in FRCC. This compares to the cost of emissions reductions from corn ethanol, which is about $750/ton of CO2, as reported by Congressional Budget Office'. Finally, a comparison was made between the results of the hourly dispatch model and the ReEDS model, a more complex model developed by Department of Energy's (DOE) National Renewable Energy Laboratory (NREL).

Aviation and the environment : airport operations and future growth present environmental challenges : report to the Ranking Democratic Member, Committee on Transportation and Infrastructure, House of Representatives

The Ongoing Challenge of Managing Carbon Monoxide Pollution in Fairbanks, Alaska

A Study on Onshore Power for Ocean-Going Vessels in Container Terminals of Hong Kong

Achieving Sustainable Mobility

The Code of Federal Regulations of the United States of America

Special Report of the Intergovernmental Panel on Climate Change

As interest in pollutant emission from stationary and aero-engine gas turbines increases, combustor engineers must consider various configurations. One configuration of increasing interest is the staged, rich burn - quick mix - lean burn (RQL) combustor. This report summarizes an investigation conducted in a recently developed high pressure gas turbine combustor facility. The model RQL combustor was plenum fed and modular in design. The fuel used for this study is Jet-A which was injected from a simplex atomizer. Emission (CO2, CO, O2, UHC, NOx) measurements were obtained using a stationary exit plane water-cooled probe and a traversing water-cooled probe which sampled from the rich zone exit and

the lean zone entrance. The RQL combustor was operated at inlet temperatures ranging from 367 to 700 K, pressures ranging from 200 to 1000 kPa, and combustor reference velocities ranging from 10 to 20 m/s. Variations were also made in the rich zone and lean zone equivalence ratios. Several significant trends were observed. NOx production increased with reaction temperature, lean zone equivalence ratio and residence time and decreased with increased rich zone equivalence ratio. NOx production in the model RQL combustor increased to the 0.4 power with increased pressure. This correlation, compared to those obtained for non-staged combustors (0.5 to 0.7), suggests a reduced dependence on NOx on pressure for staged combustors. Emissions profiles suggest that rich zone mixing is not uniform and that the rich zone contributes on the order of 16 percent to the total NOx produced.Peterson, Christopher O. and Sowa, William A. and Samuelsen, G. S.Glenn Research CenterCOMBUSTION CHAMBERS; GAS TURBINES; CONTAMINANTS; BURNERS; NITROGEN OXIDES; JET MIXING FLOW; EXHAUST EMISSION; HIGH TEMPERATURE; CARBON DIOXIDE; COMPRESSED GAS; OXYGEN; TEST FACILITIES; EXPERIMENT DESIGN

With the prospect of new layers of complexity being added to air pollution controls, and with electricity restructuring putting a premium on economic efficiency, interest is being expressed in finding mechanisms to achieve health and environmental goals in simpler, more cost-effective ways. The electric utility industry is a major source of air pollution, particularly sulfur dioxide (SO2), nitrogen oxides (NOx), and mercury (Hg), as well as unregulated greenhouse gases, particularly carbon dioxide (CO2). At issue is whether a new approach to environmental protection could achieve the nation's air quality goals more cost effectively than the current system. One approach being proposed is a "multi-pollutant" strategy -- a framework based on a consistent set of emissions caps, implemented through emissions trading. Just how the proposed approach would fit with the current (and proposed) diverse regulatory regimes remains to be worked out; they might be replaced to the greatest extent feasible, or they might be overlaid by the framework of emissions caps. In February 2002, the Bush Administration announced two air quality initiatives. The first, "Clear Skies," would amend the Clean Air Act to place emission caps on electric utility emissions of SO2, NOx, and Hg. Implemented through a tradeable allowance program, the emissions caps would generally be imposed in two phases: 2008 and 2018. The second initiative begins a voluntary greenhouse gas reduction program. This plan, rather than capping CO2 emissions, focuses on improving the carbon efficiency of the economy, reducing current emissions of 183 metric tons per million dollars of GDP to 151 metric tons per million dollars of GDP in 2012. In the 110th Congress, three bills have been introduced that would impose multipollutant controls on utilities. They are all four-pollutant proposals that include carbon dioxide. S. 1168 and S. 1177 are revised versions of S. 2724, introduced in the 109th Congress. S. 1201 is an expanded version of S. 150, introduced in the 109th Congress. All of these bills involve some form of emission caps, beginning in the 2009-2012 time frame, with a second phase in 2013-2015. They would employ a tradeable credit program to implement the SO2, NOx, and CO2 caps while permitting plant-wide averaging in complying with the Hg requirements. The provisions concerning SO2, NOx, and Hg in the 110th Congress bills are generally more stringent than the comparable provisions of S. 131 of the 109th Congress. It is difficult to compare the CO2 caps contained in these bills with the Administration's proposal concerning CO2 -- both because the Administration's proposal is voluntary rather than mandatory and because it is broader (covering all greenhouse gas emissions rather than just utility CO2 emissions).

The goal of this research is to identify how nitrogen oxide (NOx) emissions and flame stability (blowout) are impacted by the use of fuels that are alternatives to typical pipeline natural gas. The research focuses on lean, premixed combustors that are typically used in state-of-the-art natural gas fueled systems. An idealized laboratory lean premixed combustor, specifically the jet-stirred reactor, is used for experimental data. A series of models, including those featuring detailed fluid dynamics and those focusing on detailed chemistry, are used to interpret the data and understand the underlying chemical kinetic reasons for differences in emissions between the various fuel blends. An ultimate goal is to use these data and interpretive tools to develop a way to predict the emission and stability impacts of changing fuels within practical combustors. All experimental results are obtained from a high intensity, single-jet stirred reactor (JSR). Five fuel categories are studied: (1) pure H2, (2) process and refinery gas, including combinations of H2, CH4, C2H6, and C3H8, (3) oxygen blown gasified coal/petcoke composed of H2, CO, and CO2, (4) landfill and digester gas composed of CH4, CO2, and N2, and (5) liquified natural gas (LNG)/shale/associated gases composed of CH4, C2H6, and C3H8. NOx measurements are taken at a nominal combustion temperature of 1800 K, atmospheric pressure, and a reactor residence time of 3 ms. This is done to focus the results on differences caused by fuel chemistry by comparing all fuels at a common temperature, pressure, and residence time. This is one of the few studies in the literature that attempts to remove these effects when studying fuels varying in composition. Additionally, the effects of changing temperature and residence time are investigated for selected fuels. At the nominal temperature and residence time, the experimental and modeling results show the following trends for NOx emissions as a function of fuel type: 1.) NOx emissions decrease with increasing H2 fuel fraction for combustion of CH4/H2 blends. This appears to be caused by a reduction in the amount of NO made by the prompt pathway involving the reaction of N2 with hydrocarbon radicals as the CH4 is replaced by H2. 2.) For category 2 (the process and refinery blend) and category 5 (the LNG, shale, and associated gases), NOx emissions increase with the addition of C2 and C3 hydrocarbons. This could be due to an increased production of free radicals resulting from increasing CO production when higher molecular weight hydrocarbons are broken down. 3.) For category 3 (the O2 blown gasified coal/petcoke), NOx emissions increase with increasing CO fuel fraction. The reason for this is attributed to CO producing more radicals per unit heat release than H2. When CO replaces H2, an increase in NOx emissions is seen due to an increase in the productivity of the N2O, NNH, and Zeldovich pathways. 4.) For category 4 (the landfill gas) the addition of diluents such as CO2 and N2 at constant air flow produces more NOx per kg of CH4 consumed, and N2 is more effective than CO2 in increasing the NOx emission index. The increase in emission index appears to be due to an enhancement of the prompt NOx pathway as the diluents are added and the mixture moves towards stoichiometric. In addition, the presence of CO2 as a diluent catalyzes the loss of flame radicals, leading to less NOx formation than when an equivalent amount of N2 is used as a diluent. For a selected set of fuels, detailed spacial reactor probing is carried out. At the nominal temperature and residence time, the experimental results show the following trends for flame structure as a function of fuel type: 1.) Pure H2 is far more reactive in comparison to CH4 and all other pure alkane fuels. This results in relatively flat NOx and temperature profiles; whereas, the alkane fuels drop in both temperature and NOx production in the jet, where more fresh reactor feed gases are present. 2.) For category 2 (the Process and Refinery blends), H2 addition increases reactivity in the jet while decreasing overall NOx emissions. The increased reactivity is especially evident in the CO profiles where the fuels blended with C2H6 and H2 have CO peaks on jet centerline and CO emissions for pure CH4 peaks slightly off centerline. 3.) For category 3 (the O2 blown gasified coal/petcoke), the temperature profiles for the gasification blend and pure H2 are nearly identical, which is likely due to the high reactivity of H2

dominating the relatively low reactivity of CO. Despite a small temperature difference, the addition of CO causes an increase in NOx production. 4.) For category 4 (the landfill gas), the temperature profiles are virtually indistinguishable. However, the addition of diluent decreases reactivity and spreads out the reaction zone with the CO concentration peaking at 2 mm off of centerline instead of 1 mm. Diluent addition increases NOx production in comparison to pure CH4 for reasons explained above. 5.) For category 5 (the LNG, shale, and associated gases), the temperature profiles are all very similar. The increased reactivity of C2H6 is evident from looking at the CO profiles. Increased C2H6 promotes CO production on jet centerline which is indicative of the hydrocarbon material breaking down earlier in the jet. At temperatures and residence times other than the nominal conditions, the experimental results show the following trends: 1,) The NOx emissions from LPM combustion of pure CH4, H2, C2H6, and C3H8 are shown to vary linearly with residence time and in an Arrhenius fashion with temperature. This occurs because (1) more reaction time leads to more NOx formation, and (2) NOx formation is a strong, non-linear function of temperature. 2.) The addition of both H2 and C2H6 to a LPM CH4 flame is effective at extending its lean blowout limit. The results of both two and three dimensional CFD simulations are presented to illustrate the general flow, temperature, and species structure within the reactor. Since the two dimensional model is far more computationally efficient, it is employed to study various fuel mixtures with more sophisticated chemical mechanisms. The CFD results from the LPM combustion of H2, H2/CO, and CH4 with NOx formation are presented. A three dimensional CFD simulation is run for LPM CH4 combustion that uses a global CH4 oxidation mechanism. While this model does not predict intermediate radicals and NOx, the CO contours and flow field can be used as guidelines to develop a chemical reactor network (CRN), which can incorporate detailed chemistry. In addition, this model runs quickly enough that it is a good way to initialize the temperature and flow field for simulations that do incorporate more complex chemistry. The two dimensional model is used to illustrate the difference in combustion behavior between the various fuels tested. In particular, it illustrates the geometric locations of the super-equilibrium radical fields and shows where and through which pathways NOx is formed. The pathway breakdowns show good agreement with the CRN modeling results. The main goal of the CFD modeling is to use the results of each model to develop Chemical Reactor Networks, CRNs, that are customized for a particular burner. The CRN can then be used to estimate the impacts due to fuel variation.

Motor vehicles are a major source of greenhouse gas and other pollutant emissions that contribute to global climate change and urban and regional air pollution problems. Past efforts to develop motor vehicle emission inventories, needed for air quality planning, have been subject to significant uncertainties related to emission factors and spatial and temporal distributions of vehicle activity. The goal of this dissertation is to develop new inventories for vehicle emissions of greenhouse gases and co-emitted pollutants. A two-step approach was followed. First, motor vehicle emissions of carbon dioxide were mapped spatially and temporally using real-world traffic count data. The mapping was done separately for light- and heavy-duty vehicles so that emission factors specific to each vehicle type could be used to estimate associated air pollutant emissions. Second, long-term trends in emissions of nitrogen oxides, carbon monoxide, volatile organic compounds, and black carbon were analyzed. Emission trends were compared with long-term changes in the measured atmospheric concentrations of related pollutants, to assess the extent to which observed decreases in pollution can be attributed to motor vehicle emission control policies. The resulting motor vehicle emission inventories from this dissertation are more reliable than previous vehicle emission estimates, because spatial and temporal patterns of vehicle activity are explicitly accounted for using real-world traffic count data rather than transportation demand models, and emission factors are derived from real-world on-road studies rather than from laboratory testing. A fuel-based inventory for vehicle emissions is presented for carbon dioxide (CO2), and mapped at various spatial resolutions (10 km, 4 km, 1 km, and 500 m) using fuel sales and traffic count data. The mapping is done separately for gasoline-powered vehicles and heavy-duty diesel trucks. Emissions estimates from this study are compared with the Emissions Database for Global Atmospheric Research (EDGAR) and VULCAN. All three inventories agree at the national level within 5%. EDGAR uses road density as a surrogate to apportion vehicle emissions, which leads to 20-80% overestimates of on-road CO2 emissions in the largest U.S. cities. High-resolution emission maps are presented for Los Angeles, New York City, San Francisco-San Jose, Houston, and Dallas-Fort Worth. Sharp emission gradients that exist near major highways are not apparent when emissions are mapped at 10 km resolution. High CO2 emission fluxes over highways become apparent at grid resolutions of 1 km and finer. Temporal variations in vehicle emissions are characterized using extensive day- and time-specific traffic count data, and are described over diurnal, day of week, and seasonal time scales. Clear differences are observed when comparing light- and heavy-duty vehicle traffic patterns and comparing urban and rural areas. Decadal emission trends were analyzed from 2000 to 2007 when traffic volumes were increasing, and a more recent period (2007-2010) when traffic volumes declined due to recession. We found large non-uniform changes in on-road CO2 emissions over a period of ~5 years, highlighting the importance of timely updates to motor vehicle emission inventories. A similar approach is used to estimate nitrogen oxide (NOx = NO + NO2) emissions from gasoline- and diesel-powered motor vehicles. Estimates are made at the national level for the period 1990 to 2010. Vehicle emissions are also estimated at the state level for California, and for the South Coast (Los Angeles) and San Joaquin Valley air basins. Fuel-based emission estimates are compared with predictions from widely used emission inventory models. Changes in diesel NOx emissions vary over time: increasing between 1990 and 1997, stable between 1997 and 2007, and decreasing since 2007. In contrast, gasoline engine-related NOx emissions have decreased steadily, by ~65% overall between 1990 and 2010, except in the San Joaquin Valley where reductions were not as large due to faster population growth. In the San Joaquin Valley, diesel engines were the dominant on-road NOx source in all years considered (reaching ~70% in 2010). In the urbanized South Coast air basin, gasoline engine emissions dominated in the past, and have been comparable to on-road diesel sources since 2007 (down from ~75% in 1990). Other major anthropogenic sources of NOx are added to compare emission trends with trends in surface pollutant observations and satellite-derived data. When all major anthropogenic NOx sources are included, the overall emission trend is downward in all cases (-45% to -60%). Future reductions in motor vehicle NOx will depend on the effectiveness of new exhaust after-treatment controls on heavy-duty trucks, as well as further improvements to durability of emission control systems on light-duty vehicles. Long-term trends in carbon monoxide (CO) emissions from motor vehicles were also assessed. Non-methane hydrocarbons (NMHC) are estimated based on my CO emission inventory, using ambient NMHC/CO ratios that were adjusted to exclude NMHC contributions from non-vehicular sources. Despite increases in fuel use of ~10-40%, CO running exhaust emissions from on-road vehicles decreased by ~80-90% in Los Angeles, Houston, and New York City, between 1990 and 2010. The ratio of NMHC/CO was found to remain constant at 0.24 " 0.04 mol C/mol CO over time in Los Angeles, indicating that emissions of both NMHC and CO decreased at a similar rate and were affected by similar emission control policies, whereas on-road data from

other cities suggest rates of reduction in NMHC versus CO emissions may differ somewhat. Emission ratios of CO/NOx (nitrogen oxides = NO + NO2) and NMHC/NOx decreased by a factor of ~4 between 1990 and 2007 due to changes in the relative emission rates of passenger cars versus diesel trucks, and slight uptick thereafter, consistent across all urban areas considered here. These pollutant ratios are expected to increase in future years due to (1) slowing rates of decrease in CO and NMHC emissions from gasoline vehicles, and (2) significant advances in control of diesel NOx emissions. New estimates of particulate matter (PM) and black carbon (BC) emissions from heavy-duty diesel trucks in the Los Angeles area were developed as part of this research. Emission trends are compared with trends in ambient concentrations of particulate black and organic carbon over a 35-year period starting in 1975. On-road heavy-duty diesel emission factors of PM and BC have decreased by a factor of ~4 since 1975. After accounting for rapid growth in diesel fuel sales, on-road diesel BC emissions were found to have decreased by only ~20% between 1975 and 2010. In contrast, ambient measurements of BC concentrations in the Los Angeles basin show a clear downward trend, and have decreased steadily at an average rate of 4.2% per year since 1975. The slopes of best-fit lines in plots of measured OC versus BC concentrations have remained remarkably consistent over time. The stability of this ratio over time implies similar long-term trends in ambient black and organic carbon concentrations. We estimate that ambient OC levels in the Los Angeles basin have decreased by ~3.1% per year since 1975. Ongoing debate about the relative importance of gasoline versus diesel vehicle VOC emission contributions to secondary organic aerosol formation in urban areas is further informed by this research. Between 1995 and 2010, gasoline VOC emissions show a steeper downward trend, decreasing by 75 " 7% compared to OC which decreased by only 45 " 22%. The difference in slopes suggests that other sources of particulate organic carbon must also be contributing to the differing trends. When including other primary and secondary sources of organic aerosols from motor vehicles, the ambient and emission trends strongly agree. We conclude that long-term decreases in ambient OC likely resulted from efforts to control on-road gasoline emissions of VOCs. However, as a consequence of these efforts, other sources of organic aerosols have grown in relative importance including emissions from diesel trucks. Recommendations for future research include development of urban CO2 monitoring networks, modeling effects on air quality of long-term changes in motor vehicle emissions, and projecting future motor vehicle emissions and associated impacts on air quality.

On-road Measurement of NOx and CO2 Emissions from Biodiesel Produced from Different Feedstocks

Effectiveness of Signal Coordination as an Emission Reduction Measure for Vehicles

Clean and Efficient Coal-fired Power Plants

Opportunities for Substantial CO2 Emissions Reductions

Carbon Dioxide Capture and Storage

Throughout the world, research and development in the field of vehicle transportation is increasingly focusing on engine and fuel combinations. The conventional and alternative fuels of the future are seen as fundamental to the development of a new generation of internal combustion engines that attain low well-to-wheel CO2 emissions along with near-zero pollutant emissions. These issues were debated during an international conference whose proceedings are presented in this book. This international conference attracted specialists in the field, including participants from universities, research centres and industry.Contents : Future of liquid fuels, Engine and fuel-related issues in HCCI & CAI combustion, Energy conversion in engines from natural gas, Use of hydrogen in IC engines, Which fuels for low CO2 engines?

Climate Change : Looking forward, ninth report of session 2004-05, Vol. 2: Oral and written Evidence

As much as 70 to 75% of the energy in the fuel used by a car is turned into waste heat, with more than a third of this released through the exhaust pipe. Catalysis offers a way of recovering exhaust heat. By adding some of the fuel to a portion of the exhaust as it passes through a catalytic reactor, it is possible to produce a gas mixture with a higher heating value than the fuel. This strategy depends, however, on the catalytic reaction consuming heat, while generating readily-combustible products that can be fed back to the engine. An investigation into catalytic exhaust gas fuel reforming and its potential to improve engine emissions and efficiency when close-coupled to a spark ignition engine. Initial ethanol reforming reactions with simulated exhaust gas suggests that the desired reforming path, i.e. dry reforming, steam reforming and partial oxidation reforming reactions can raise the heating value of the input fuel (ethanol) by up to 120% providing exhaust gas temperatures are made available, with the highest being steam reforming > dry reforming > oxidative reforming. The undesired water gas shift reaction is inactive with this reforming catalyst, regardless of the reaction temperature and reactant ratios (e.g. O:C and H\(_2\)O:C). The characteristic of each reforming path is tentatively explained with deviations from the stoichiometry. Actual exhaust gas fuel reforming studies of gasoline is carried out at a range of exhaust gas temperatures. It was found that at exhaust gas temperature 600\(0\) to 950\(0\)C, the overall process efficiency ranges from 107 to 119%. By replacing 23.9% of gasoline fuel with simulated reformate, improvements in engine specific fuel consumption (SFC) and emissions (e.g. NOx, HC, CO2, CO) was achieved.

Aircraft emissions currently account for ~3.5% of all greenhouse gas emissions. The number of passenger miles has increased by 5% annually despite 9/11, two wars and gloomy economic conditions. Since aircraft have no viable alternative to the internal combustion engine, improvements in aircraft efficiency and alternative fuel development become essential. This book comprehensively covers the relevant issues in green aviation. Environmental impacts, technology advances, public policy and economics are intricately linked to the pace of development that will be realized in the coming decades. Experts from NASA, industry and academia review current technology development in green aviation that will carry the industry through 2025 and beyond. This includes increased efficiency through better propulsion systems, reduced drag airframes, advanced materials and operational changes. Clean combustion and emission control of noise, exhaust gases and particulates are also addressed through combustor design and the use of alternative fuels. Economic imperatives from aircraft lifetime and maintenance logistics dictate the drive for "drop-in" fuels, blending jet-grade and biofuel. New certification standards for alternative fuels are outlined. Life Cycle Assessments are used to evaluate worldwide biofuel approaches, highlighting that there is no single rational approach for sustainable buildup. In fact, unless local conditions are considered, the use of biofuels can create a net increase in environmental impact as a result of biofuel manufacturing processes. Governmental experts evaluate current and future regulations and their impact on green

aviation. Sustainable approaches to biofuel development are discussed for locations around the globe, including the US, EU, Brazil, China and India.

Performance of a Model Rich Burn-Quick Mix-Lean Burn Combustor at Elevated Temperature and Pressure

Green Certificate Systems and a Greenhouse Gas Emission Permit Trading System

2000-

Advanced Power Plant Materials, Design and Technology

Costs and Benefits of Clear Skies

Climate Change

The important advances achieved over the past years in all technological directions (industry, energy, and health) contributing to human well-being are unfortunately, in many cases, accompanied by a threat to the environment, with photochemical smog, stratospheric ozone depletion, acid rain, global warming, and finally climate change being the most well-known major issues. These are the results of a variety of pollutants emitted through these human activities. The indications show that we are already at a tipping point that might lead to non-linear and sudden environmental change on a global scale. Aiming to tackle these adverse effects in an attempt to mitigate any damage that has already occurred and to ensure that we are heading toward a cleaner (green) and sustainable future, scientists around the world are developing tools and techniques to understand, monitor, protect, and improve the environment. Emissions control catalysis is continuously advancing, providing novel, multifunctional, and optimally promoted using a variety of methods, nano-structured catalytic materials, and strategies (e.g., energy chemicals recycling, cyclic economy) that enable us to effectively control emissions, either of mobile or stationary sources, improving the quality of air (outdoor and indoor) and water and the energy economy. Representative cases include the abatement and/or recycling of CO2, CO, NOx, N2O, NH3, CH4, higher hydrocarbons, volatile organic compounds (VOCs), particulate matter, and specific industrial emissions (e.g., SOx, H2S, dioxins aromatics, and biogas). The " Emissions Control Catalysis " Special Issue has succeeded in collecting 22 high-quality contributions, included in this MDPI open access book, covering recent research progress in a variety of fields relevant to the above topics and/or applications, mainly on: (i) NOx catalytic reduction from cars (i.e., TWC) and industry (SCR) emissions; (ii) CO, CH4, and other hydrocarbons removal, and (iii) CO2 capture/recirculation combining emissions control with added-value chemicals production.

Nitrogen oxides (NOx) why and how they are controlledDIANE PublishingAchieving the "Dual Targets" of CO2 Emission Reduction and Air Quality Improvement for Chinese Cities

The Asia – Pacific Integrated Model (AIM) brings together more than 20 computer simulation models for development and analysis of policy in such diverse fields as climate change mitigation, air pollution abatement, and ecosystem preservation. This first book in a series on the development of AIM focuses on climate change issues and the evaluation of policy options to stabilize the global climate. It presents an overview of the models developed to date, their structure, and the results and analyses presented to policymakers and researchers at the levels of individual Asian countries, the Asia – Pacific region, and the world at large. The contents vary in scope from local to global issues, with discussions of the effects of climate policies, cost analyses of climate policies with their effects on trade, and global scenario analyses. Also included are impact analyses and the effects of promoting environmental technologies.

Carbon monoxide (CO) is a toxic air pollutant produced largely from vehicle emissions. Breathing CO at high concentrations leads to reduced oxygen transport by hemoglobin, which has health effects that include impaired reaction timing, headaches, lightheadedness, nausea, vomiting, weakness, clouding of consciousness, coma, and, at high enough concentrations and long enough exposure, death. In recognition of those health effects, the U.S. Environmental Protection Agency (EPA), as directed by the Clean Air Act, established the health-based National Ambient Air Quality Standards (NAAQS) for CO in 1971. Most areas that were previously designated as "nonattainment" areas have come into compliance with the NAAQS for CO, but some locations still have difficulty in attaining the CO standards. Those locations tend to have topographical or meteorological characteristics that exacerbate pollution. In view of the challenges posed for some areas to attain compliance with the NAAQS for CO, congress asked the National Research Council to investigate the problem of CO in areas with meteorological and topographical problems. This interim report deals specifically with Fairbanks, Alaska. Fairbanks was chosen as a case study because its meteorological and topographical characteristics make it susceptible to severe winter inversions that trap CO and other pollutants at ground level.

Near-Zero Emissions Oxy-Combustion Flue Gas Purification

Code of Federal Regulations

Everyday and Leisure-time Travel in the EU

High-Resolution Mapping and Long-Term Trends for Motor Vehicle Emissions

Potentially Available Natural Gas Combined Cycle Capacity

Exhaust Gas Fuel Reforming to Achieve Fuel Saving

The Siggenthal cement works has a rotary cement kiln with a maximum daily clinker output of 2,000 tonnes. The need to comply with environmental requirements prompted the cement works operators to lower the high exhaust gas concentration of NOx, NH3 and SO2. The cement works installed tw systems: injection of ammonia water and collection of harmful substances by adsorption in an active coal filter. A substantial substitution of coal, used t supply heat for the production process, could be achieved together with a reduction in NOx and CO2 emissions by a factor of two. Most importantly, th emission reductions were achieved even when fuel substitutes such as dried sewage sludge were used.

Special edition of the Federal Register, containing a codification of documents of general applicability and future effect ... with ancillaries.

The objectives of this project were to carry out an experimental program to enable development and design of near zero emissions (NZE) CO2 process unit (CPU) for oxy-combustion plants burning high and low sulfur coals and to perform commercial viability assessment. The NZE CPU was proposed t produce high purity CO2 from the oxycombustion flue gas, to achieve> 95% CO2 capture rate and to achieve near zero atmospheric emissions of crite pollutants. Two SOx/NOx removal technologies were proposed depending on the SOx levels in the flue gas. The activated carbon process was propos power plants burning low sulfur coal and the sulfuric acid process was proposed for power plants burning high sulfur coal. For plants burning high sulfu coal, the sulfuric acid process would convert SOx and NOx in to commercial grade sulfuric and nitric acid by-products, thus reducing operating costs associated with SOx/NOx removal. For plants burning low sulfur coal, investment in separate FGD and SCR equipment for producing high purity CO2 would not be needed. To achieve high CO2 capture rates, a hybrid process that combines cold box and VPSA (vacuum pressure swing adsorption) wa proposed. In the proposed hybrid process, up to 90% of CO2 in the cold box vent stream would be recovered by CO2 VPSA and then it would be recyc and mixed with the flue gas stream upstream of the compressor. The overall recovery from the process will be> 95%. The activated carbon process wa able to achieve simultaneous SOx and NOx removal in a single step. The removal efficiencies were>99.9% for SOx and>98% for NOx, thus exceeding performance targets of>99% and>95%, respectively. The process was also found to be suitable for power plants burning both low and high sulfur coals Sulfuric acid process did not meet the performance expectations. Although it could achieve high SOx (>99%) and NOx (>90%) removal efficiencies, it

could not produce by-product sulfuric and nitric acids that meet the commercial product specifications. The sulfuric acid will have to be disposed of by neutralization, thus lowering the value of the technology to same level as that of the activated carbon process. Therefore, it was decided to discontinue further efforts on sulfuric acid process. Because of encouraging results on the activated carbon process, it was decided to add a new subtask on testin process in a dual bed continuous unit. A 40 days long continuous operation test confirmed the excellent SOx/NOx removal efficiencies achieved in the operation. This test also indicated the need for further efforts on optimization of adsorption-regeneration cycle to maintain long term activity of activated carbon material at a higher level. The VPSA process was tested in a pilot unit. It achieved CO2 recovery of> 95% and CO2 purity of>80% (by vol.) from simulated cold box feed streams. The overall CO2 recovery from the cold box VPSA hybrid process was projected to be>99% for plants with low air ingress (2%) and>97% for plants with high air ingress (10%). Economic analysis was performed to assess value of the NZE CPU. The advantage of NZ CPU over conventional CPU is only apparent when CO2 capture and avoided costs are compared. For greenfield plants, cost of avoided CO2 and cost captured CO2 are generally about 11-14% lower using the NZE CPU compared to using a conventional CPU. For older plants with high air intrusion, th cost of avoided CO2 and capture CO2 are about 18-24% lower using the NZE CPU. Lower capture costs for NZE CPU are due to lower capital investm in FGD/SCR and higher CO2 capture efficiency. In summary, as a result of this project, we now have developed one technology option for NZE CPU b on the activated carbon process and coldbox-VPSA hybrid process. This technology is projected to work for both low and high sulfur coal plants. The N CPU technology is projected to achieve near zero stack emissions, produce high purity CO2 relativ ...

All federal agencies, including EPA, are required under Executive Order (EO) 13123 to reduce life-cycle greenhouse gas emissions attributed to facility energy use by 30% below 1990 levels by 2010. A key approach to reducing facility greenhouse gas emissions, employed by EPA's Office of Administra and Resources Management (OARM), involves the purchase of "green power". Green power generally includes renewables (wind, solar, biomass) and other clean energy technologies (municipal solid waste and landfill gas) that generate electricity. Green tags, which represent the positive environment attributes associated with electricity production from green power sources, are sold through markets to electricity consumers. The analysis presented in this report meets the following three objectives: (1) establish the 1990 EPA emissions baseline in order to assess progress towards fulfillment of EO 13 (2) examine the impact of EPA's green power purchasing on facility-related greenhouse gas emissions and air pollution, and (3) develop a strategy for future green power purchases. In order to achieve these objectives, this report describes a new method to estimate net emissions of CO2, SO2, NOX, Hg. The estimation of net facility emissions is complicated by the purchase of green tags because it requires detailed knowledge of which conventional power plants are being offset by purchased green power. Different offset scenarios are analyzed in order to quantify the uncertainty inherent in estimat emissions offsets without hour-by-hour system dispatch data.

The Impact of EPA's Green Power Purchases

A Study of Pollutant Formation from the Lean Premixed Combustion of Gaseous Fuel Alternatives to Natural Gas

Development Toward Advanced Technologies

Achieving the "Dual Targets" of CO2 Emission Reduction and Air Quality Improvement for Chinese Cities

Federal Register

Substitution of Coal in Cement Industry Reduces Pollution

Over the last several years, there has been much discussion on the interrelation of CO2 emissions with the global warming phenomenon. This in turn has increased pressure to develop and produce more fuel efficient engines and vehicles. This is the central topic of this book. It covers the underlying processes which cause pollutant emissions and the possibilities of reducing them, as well as the fuel consumption of gasoline and diesel engines, including direct injection diesel engines. As well as the engine-related causes of pollution, which is found in the raw exhaust, there is also a description of systems and methods for exhaust post treatment. The significant influence of fuels and lubricants (both conventional and alternative fuels) on emission behavior is also covered. In addition to the conventional gasoline and diesel engines, lean-burn and direct injection gasoline engines and two-stroke gasoline and diesel engines are included. The potential for reducing fuel consumption and pollution is described as well as the related reduction of CO2 emissions. Finally, a detailed summary of the most important laws and regulations pertaining to pollutant emissions and consumption limits is presented. This book is intended for practising engineers involved in research and applied sciences as well as for interested engineering students.

Fossil-fuel power plants account for the majority of worldwide power generation. Increasing global energy demands, coupled with issues of ageing and inefficient power plants, have led to new power plant construction programmes. As cheaper fossil fuel resources are exhausted and emissions criteria are tightened, utilities are turning to power plants designed with performance in mind to satisfy requirements for improved capacity, efficiency, and environmental characteristics. Advanced power plant materials, design and technology provides a comprehensive reference on the state of the art of gas-fired and coal-fired power plants, their major components and performance improvement options. Part one critically reviews advanced power plant designs which target both higher efficiency and flexible operation, including reviews of combined cycle technology and materials performance issues. Part two reviews major plant components for improved operation, including advanced membrane technology for both hydrogen (H2) and carbon dioxide (CO2) separation, as well as flue gas handling technologies for improved emissions control of sulphur oxides (SOx), nitrogen oxides (NOx), mercury, ash and particulates. The section concludes with coverage of high-temperature sensors, and monitoring and control technology that are essential to power plant operation and performance optimisation. Part three begins with coverage of low-rank coal upgrading and biomass resource utilisation for improved power plant fuel flexibility. Routes to improve the environmental impact are also reviewed, with chapters detailing the integration of underground coal gasification and the application of carbon dioxide (CO2) capture and storage. Finally, improved generation performance is reviewed with coverage of syngas and hydrogen (H2) production from fossil-fuel feedstocks. With its distinguished international team of contributors, Advanced power plant materials, design and technology is a standard reference for all power plant engineers and operators, as well as to academics and researchers in this field. Provides a comprehensive reference on the state-of-the-art gas-fired and coal-fired power plants, their major components and performance improvement

options Examines major plant components for improved operation as well as flue gas handling technologies for improved emissions control Routes to improve environmental impact are discussed with chapters detailing the integration of underground coal gasification

"The electric utility industry is a major source of air pollution, particularly sulfur dioxide (SO2), nitrogen oxides (NOx), and mercury (Hg), as well as suspected greenhouse gases, particularly carbon dioxide (CO2). On October 27, 2005, the Environmental Protection Agency (EPA) released a long-awaited analysis comparing the costs and benefits of alternative approaches to controlling this pollution. The alternative schemes focus on using market-oriented mechanisms directed at multiple pollutants to achieve health and environmental goals. The new analysis compares four versions of the Administration-based "Clear Skies" proposal to bills introduced by Senator Jeffords (S. 150) and Senator Carper (S. 843 of the 108th Congress), which would impose more stringent requirements. This report examines EPA's analysis and adjusts some of its assumptions to reflect current regulations. The most important adjustment is the choice of baseline. The agency's analysis assumes as a baseline that, in the absence of new federal legislation, EPA and the states will take no additional action to control SO2, NOx, Hg, or CO2 emissions beyond those actions finalized by mid-2004. This baseline is put forth despite three rules recently promulgated by EPA that limit SO2, NOx, and Hg emissions on a timeframe similar to that proposed by the Clear Skies legislation. CRS reexamines EPA's data, producing cost and benefit estimates for each bill incremental to the costs and benefits of current law and promulgated regulations. The reanalysis finds that Clear Skies would have negligible incremental costs and added benefits of $6 billion in 2010 and $3 billion in 2020. For the same years, S. 843 would have annual net benefits 8 and 5 times as great as Clear Skies at annual costs of $4.2 billion and $3 billion, and S. 150 would have annual net benefits 10 and 16 times those of Clear Skies at annual costs of $23.6 billion and $18.1 billion. EPA conducted limited sensitivity analyses to examine the effect on cost of select combinations of assumptions, including (1) the responsiveness of electricity demand to changes in price; (2) the availability of skilled labor to install control equipment; and (3) the growth of electricity demand and natural gas prices. However, some potentially useful combinations of assumptions were not examined. For example, if EPA had combined a relaxed skilled labor constraint with some responsiveness of electricity demand to changes in price, the cost of S. 150 and S. 843 would be substantially reduced. CRS also concluded that the Hg control costs used in the analysis may be substantially overstated because of dated assumptions. Numerous benefits were not estimated by EPA, partly because of methodological difficulties. Benefits not estimated include the environmental (as opposed to health) benefits of controlling the pollutants; the health effects of mercury control; and any benefits from controlling CO2 emissions. Thus, even though benefits exceeded costs for each of the options in both EPA's and our analysis, one should perhaps view the benefit estimates as a floor rather than a best estimate, particularly for S. 150 and S. 843, which include significant Hg and CO2 reductions."--Page 1.

Sustainable mobility has become the new imperative for transport policy. There have been a number of policy attempts at sustainable mobility globally, such as the development of more efficient conventional transport technologies, the promotion of efficient and affordable public transport systems and the encouragement of environmental awareness. Such policies have so often been presented as prerequisites for sustainable mobility that they are now taken for granted. But are any of these policies really successful? To what extent do they actually contribute (or fail to contribute) to sustainable mobility? Why do some policies succeed and others fail? Using an interdisciplinary approach which brings together various theories and methodologies, this book tests each of these policies – or hypotheses, as the author sees them – with detailed empirical investigations. It also argues that leisure-time travel should be included in any sustainable mobility policies, as it now accounts for 50 per cent of all annual travel distance in developed countries. The book concludes by suggesting fourteen theses of sustainable mobility for the EU and a new model for future best practice.

Carbon Dioxide Capture for Storage in Deep Geologic Formations - Results from the CO2 Capture Project

Information Circular

Which Fuels for Low CO2 Engines?

Energy and Sustainability VII

Looking Forward, Ninth Report of Session 2004-05, Vol. 2: Oral and Written Evidence

Air Quality

Permit trading is an environmental policy instrument that has received increasing levels of attention over recent years. Coming from the field of air quality management, with the European CO2 emissions trading system being the most prominent example, it enters new fields of application, such as land use policy and biodiversity protection, water quality and water quantity trading. This book gives an overview of these recent developments and discusses the possibilities and limits of permit trading in environmental policies. The advantages of permit trading are not only seen with respect to economic efficiency, which leads to achieving the environmental target at minimum cost, but also with respect to the instrument's environmental effectiveness. By setting a cap for the overall emissions, a

given environmental target can be met. This makes permit trading an interesting case for many environmental fields where safeguarding the environmental target plays a dominant role. Against this background, permit trading is discussed in environmental policy fields, where it has not been considered before, for example, land use management, biodiversity protection and water trading. Permit Trading in Different Applications analyses the properties of permit trading: its possibilities and limitations, its design options and its restrictions on a more general level. It demonstrates how lessons learnt in established policy fields like air quality management can be transferred to new and emerging fields of application. This collection will provide students and practitioners in environmental sciences and policy with valuable research into instrument choice and design with respect to permit trading.

China is facing the challenges of both climate change and air pollution. To tackle the challenges, China has set specific goals, such as the CO2 emission peak target by 2030 and the "Beautiful China" target by 2035, to reduce greenhouse gases and air pollutant emissions. Cities in China play an important role as they are the fundamental units to implement reduction policies. In this dissertation, we investigate the pathway for Chinese cities to achieve the dual targets of CO2 emission reduction and air quality improvement. This work is divided into the following five chapters: an overview (Chapter 1), three chapters of original research (Chapters 2 - 4), conclusions and future work (Chapter 5).We first make a comprehensive assessment of air quality and CO2 emission changes from 2015 to 2019 for 335 Chinese cities, using the city-level data of PM2.5 and O3 concentrations and CO2 emissions. We select important regions for air pollution control in China and categorize all cities into different classes according to their development levels. Then we compare the changes of air quality and CO2 emission by region or city class. We find that PM2.5 concentrations decrease remarkably from 2015 to 2019 due to mandatory city-level PM2.5 reduction targets, especially in the Beijing-Tianjin-Hebei and Yangtze River Delta regions. Nonetheless, O3 concentrations increase in 91% of Chinese cities and CO2 emissions increase in 69% of the cities. The changes in CO2 emissions are significantly lower in developed cities compared to developing cities, which is mainly driven by the reduction in energy intensity and the improvement in energy structure. Our findings indicate a lack of synergy in air quality improvement and CO2 emission reduction in China under the current policy framework. To tackle the challenges of both air pollution and CO2 mitigation, we suggest that cities set mandatory city-level CO2 emission reduction targets and reinforce energy-related measures in future policies. To address the inconsistency in current CO2 and air pollutants emission inventories, we then develop a unified emission inventory including both emissions. We also identify the co-hotspots of both CO2 and air pollutants emissions at a high spatial resolution (1 1 km2). Using Guangzhou city as a case, we find that the stationary combustion sector and the transportation sector are the main contributors to CO2 and air pollutants emissions, together accounting for 95%, 67%, and 93% of total CO2, SO2, and NOx emissions. The co-hotspots analysis shows that more than 66% of total CO2 and air pollutants emissions are originated from the top 10% emission grids. Our findings enable accurate identification of high-emission grids, which improve the precision and effectiveness in the collaborative control of CO2 and air pollutants. Lastly, we propose a pathway for Chinese cities to reach the dual targets of CO2 emission reduction and air quality improvement. Using Yantai city as a case, we develop an integrated assessment model that couples the emission projection, air quality, and health assessment. We find that strict energy-related measures can help Yantai meet the national annual PM2.5 standard of 35 g/m3 by 2030 and achieve the carbon neutrality goals by 2060. Energy-related measures contributed to 53% and 79% of PM2.5 reduction in 2035 and 2060, exhibiting an increasing potential in improving air pollutants emissions compared to the advanced end-of-pipe controls. We find that the future health benefit from improved air quality will likely compensate for the abatement cost of implementing energy measures, with a net monetized benefit of 1.9 billion Chinese yuan in 2060. Our findings could provide a reference for Chinese cities to deal with the dual challenges in the future. Overall, we find a lack of synergy in air quality improvement and CO2 emission reduction in China under the current policy framework. The unified emission inventory and co-hotspots analysis provide a basis to design collaborative control strategies. The proposed dual targets pathway can guide Chinese cities to address both challenges in future policy design.

In August 2018, the U.S. Environmental Protection Agency (EPA) proposed three actions in the "Affordable Clean Energy Rule" (ACE). First, EPA proposed to replace the Obama Administration's 2015 Clean Power Plan (CPP) with revised emission guidelines for existing fossil fuel steam electric generating units (EGUs), which are largely coal-fired

units. Second, EPA proposed revised regulations to implement emission guidelines under Clean Air Act (CAA) Section 111(d). Third, EPA proposed to modify an applicability determination for New Source Review (NSR), a CAA preconstruction permitting program for new and modified stationary sources. The first action stems from EPA's finding that the CPP exceeded EPA's statutory authority by using measures that applied to the power sector rather than measures carried out within an individual facility. In the ACE rule, EPA proposed to base the "best system of emission reduction" (BSER) for existing coal-fired EGUs on heat rate improvement (HRI) measures. EPA did not propose a BSER for other types of EGUs, such as natural gas combined cycle units. In addition, EPA did not establish a numeric performance standard as the agency did in the CPP. Instead, EPA proposed a list of "candidate technologies" of HRI measures that constitute the BSER. States would establish unit-specific performance standards based on this list and other unit-specific considerations. Second, EPA proposed to revise the general implementing regulations to clarify EPA's and states' roles under Section 111(d) based on the agency's current legal interpretation that states have broad discretion to establish emissions standards consistent with the BSER. The proposed changes would, among other things, revise definitions and lengthen the time for development and review of state plans. Third, EPA proposed to revise the NSR applicability test for EGUs. According to EPA, this would prevent NSR from discouraging the installation of energy-efficiency measures. EGUs that adopt HRI measures and operate more efficiently may be used for longer time periods, thereby increasing annual emissions and potentially triggering NSR. Under ACE, NSR would not be triggered if the EGU modification did not increase emissions on an hourly basis, even if the modification increases annual emissions. EPA estimated emission changes under multiple scenarios. EPA projected that power sector emissions of carbon dioxide (CO2), sulfur dioxide (SO2), and nitrogen oxides (NOx) would increase under the ACE proposal compared to the CPP. EPA also projected that ACE would, in most scenarios, decrease CO2, SO2, and NOx emissions compared to a baseline without the CPP. Power sector emissions projections, comparing CPP and non-CPP scenarios, provide context for evaluating the potential impacts of the ACE proposal. The CO2 emission reduction differences between CPP and non-CPP scenarios are greater in the studies from earlier years. For example, a comparison between CPP and non-CPP scenarios from the past three Energy Information Administration analyses shows that the percentage difference has decreased from 16% (in 2016) to 8% (in 2018), reflecting the fact that many of the changes EPA expected to result from the CPP (i.e., natural gas and renewables replacing coal-fired units) have happened already due to market forces and other factors. Comparisons between modeling projections of electricity sector CO2 emissions should be made with caution, however, given potential differences in modeling assumptions about future economic conditions and underlying energy inputs (e.g., natural gas prices). EPA estimated that compared to the CPP, ACE would reduce compliance costs and yield lower emission reductions, thereby increasing climate-related damages and human health damages ("forgone benefits"). According to EPA, the estimated value of the forgone benefits would outweigh the compliance cost savings when replacing the CPP with ACE, yielding net costs.

Abstract: One of the major environmental challenges facing our planet and living beings is the global warming. This phenomena, known as the gradual increase in the overall temperature of earth's atmosphere is mostly caused by the greenhouse eect which is a result of increased levels of greenhouse gases. Major constitutes of these gases are Carbon Dioxide (CO2) and Nitrogen Oxides (NOx). Transportation sector is responsible for releasing a signicant portion of these gases into the atmosphere. In recent decades, many endeavors such as using alternative fuels and modications in engine cycles have been made to control the amount of pollutants emitted from internal combustion engines. In this work, the impact of adding humidity to the input Oxidizer stream on reduction of NOx and Carbone Dioxide (CO2) of a CNG engine has been studied. With the addition of the humidity, the combustion temperature will be reduced which improves the engines lifespan. Non-Premixed combustion process in a single cylinder is simulated using the STAR CCM+ software from CD-Adapco company, using the Presumed Probability Density Function (PPDF) combustion model which is an accurate model for combustion. Simulation results indicate with 10% humid air, signicant reductions in NOx and CO2 are obtained, with a moderate increase in CO output.

Reduction of Environmental Impact Through Aircraft Technology and Alternative Fuels

EPA's Analysis of Multi-pollutant Clean Air Bills

Proceedings of the International Conference Held in Rueil-Malmaison, France, September, 22-23, 2004

Quantitative Regional Economic and Environmental Analysis for Sustainability in Korea

CLEAN POWER ACT... HEARINGS... S. HRG. 107-570... COMMITTEE ON ENVIRONMENT & PUBLIC WORKS, UNITED STATES SENATE... 107TH CONGRESS, 1ST & 2ND

Asia-Pacific Integrated Modeling

Carbon Dioxide Capture for Storage in Deep Geologic Formations - Results from the CO2 Capture Project

The Code of Federal Regulations is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

Permit Trading in Different Applications

Reduced Emissions and Fuel Consumption in Automobile Engines

Climate Policy Assessment

Multi-pollutant Legislation in the 110th Congress

NOx Reduction in a Compressed Natural Gas (CNG) Engine with Humid Air Intake

Nitrogen oxides (NOx) why and how they are controlled