Linde applauds DOE's efforts to provide a comprehensive review of the portfolio of existing and emerging energy solutions that can help our country meet its tremendous energy and environmental challenges. We share DOE's belief that coal and natural gas will continue to be extremely important contributors to meeting these challenges. We further concur advances in enabling technologies, such as carbon capture and sequestration (CCS), will ensure these options are meeting our country's long and near-term societal interests.

We do have some significant concerns with the report we would like you to consider. Firstly, we do not understand why biogas was not identified as a viable and attractive methane source. Our recommendation is to encourage and foster the development of a diverse portfolio of methane sources, including fossil natural gas directly from pipelines and well production areas along with biogas from multiple sources. Linde has extensive experience successfully capturing and purifying biogas streams to produce liquefied and gaseous methane fuels (LNG and CNG). Some of our most ambitious work along these lines to date has been in Altamont, CA. In Altamont, we are engaged in a joint venture (JV) with Waste Management to convert landfill gas from their facility there and convert it to LNG which fuels over 300 of Waste Management's refuse trucks. This 13,000 gallon per day (gpd) facility is the world's largest land fill gas-to-LNG facility. Linde sees many opportunities to produce renewable low emission (<3g CO2/MJ) fuel throughout the country from similar feed sources. Published reviews of the biogas potential in the U.S. indicate this source can contribute as much as 10 billion gallons per year of vehicle fuels. This would be a strong supplement to the more than 10 billion gallons per year of vehicle fuel that can be provided by fossil natural gas.

Given the growing importance of natural gas to our country's energy future, we also encourage the development and deployment of advanced well completion techniques that can help economically expand natural gas production while meeting other societal needs such as managing impacts on people and the surrounding environment. Similarly, advanced enhanced oil recovery (EOR) technologies will enable the exploitation of higher percentages of oil from existing fields.

Another omission of concern in the report pertains to hydrogen and fuel cells. Nowhere in the report do we see any mention of this exciting and viable approach to our nation's energy requirements. Taking our lead from the DOE's hydrogen and fuel cell funding program, Linde has made very considerable capital and human resource investments in areas such as green hydrogen production, hydrogen storage, and hydrogen station design. We have technology **today** that would enable a fully loaded medium sized (500 kg/day) fuelling station to operate in a commercially sustainable manner **without** government funding. We have been producing 15 tons per day (tpd) of renewable hydrogen for over 25 years in our plant in Magog. QC. When that plant was built, the site and feed source were chosen entirely based upon economics. Yes, renewable hydrogen can be commercially competitive, when realized at commercial scales. We have also developed a plant that reforms renewable feedstocks such as glycerol to produce hydrogen and, via our LNG work at Altamont, we have clearly demonstrated feed methane can be recovered from even the most challenging biogas sources. Linde is intimately familiar with all aspects of hydrogen infrastructure – feedstock sourcing, production, storage, delivery, and dispensing – and we are convinced the promise of hydrogen is realizable today, at commercial scales. We would strongly encourage the DOE to not be remiss by leaving hydrogen and fuel cells out of your Quadrennial Technology Review. DOE's support to date has made the hydrogen and fuel cell program an undeniable success, with all the program's ambitious targets on schedule to be met or exceeded prior to the projected 2015 timeline. It is no coincidence that several major automotive OEMs have identified 2015 as the launch date of their first commercial fuel cell vehicles. DOE raised the bar, presented achievable stretch goals and industry robustly responded with positive results.

We appreciate the time you are taking to review and consider our and other's comments. Linde is a company that relies heavily on very large amounts of electricity and fuel to operate our core industrial gas business. We consume approximately 550 mW of electricity/year and 8.5 million gallons of fuel. We have a very sober and realistic view of our company's, our nation's and the world's energy and environmental challenges. That realistic view, coupled with the commitment we have to do no harm to the communities we serve, have led to our strong focus on the areas of biogas, natural gas, clean coal, and hydrogen as a fuel. We are committed to continue working with the DOE towards our shared goal of environmentally,

logistically and commercially sustainable solutions. We thank you for the support you have provided biogas, natural gas, clean coal, and hydrogen in the past. It has truly catalyzed and advanced our efforts significantly and strengthened our belief in and commitment to all these options.

Thank you, once again, for your careful consideration of Linde's view as both a large consumer of energy products and a knowledgeable and deliberate investor in this arena.

Best Regards,

Mike McGowan
Head of Government Relations
Linde NA
908-771-1086 (o)
845-321-3540 (c)