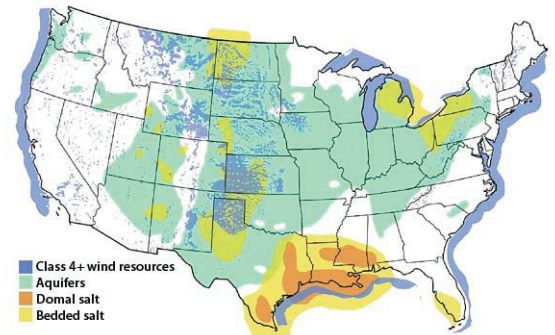


The Promise of Compressed Air Energy Storage Systems: Where Do We Stand?

The push for increased power from renewable energy has created significant challenges to managing the reliability of America's power supply system. According to the U.S. Energy Information Administration, the installed wind and solar power generating capacity increased five-fold between 2000 and 2010, yet the ability to store this energy and make it available whenever it is needed has not kept pace (the wind and the sun, by definition, are intermittent sources of energy).

Enter bulk energy storage systems. Basically, these systems work by storing energy when supply is plentiful and cheaper and providing it to the grid when energy is in high demand and more costly. Bulk energy storage systems take various forms, including pumped hydroelectric storage (PHS) systems, batteries, flywheels, and compressed air energy storage (CAES) systems. Of these technologies, only PHS and CAES are commercially available and capable of providing sufficient storage to be of value at the bulk power level. CAES systems, in particular, appear to be picking up steam as a preferred option, as evidenced by the level of government funding and the increased project development activities in the past ten years.

A CAES-based power generation facility has two primary components: 1) air compression and storage, and 2) release of the compressed air to generate electricity. Air is compressed using the energy produced from wind, solar, and other energy sources and stored in an underground salt cavern, aquifer, or abandoned mine. The released compressed air is then heated by mixing with natural gas, combusted, and exhausted through a modified turbine, which in turn drives an electrical generator to produce power when needed. Fuel efficiency is improved by recuperating heat from the turbine exhaust and using it to heat the compressed air.



The history of operating CAES systems to produce power is limited. PowerSouth Energy Cooperative's 110-MW facility in McIntosh, Alabama, constructed in 1991, is one of only two operating CAES facilities in the world, the other being E.ON-Kraftwerke's 320-MW facility in Huntorf, Germany, constructed in 1978. Both the PowerSouth and E.ON-Kraftwerke facilities rely on salt caverns for compressed air storage. After some start-up issues in the first few years of operation, the PowerSouth facility is functioning at more than 95-percent reliability.

Recognizing the potential benefits of CAES, federal, state, and local governments have provided funding for a number of new CAES projects. These recent initiatives, while yielding mixed results, have provided valuable "lessons learned" for project developers. The U.S. Department of Energy (DOE) and the California Energy Commission helped fund Pacific Gas & Electric's advanced design, 300-MW facility being developed near Bakersfield, California. The DOE also provided financing to Iberdola USA-NYSEG for its 150-MW CAES facility in Watkins Glen, New York. However, in October 2012, Iberdola informed the DOE that it was dropping the project due to the cost of site development and energy

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FROM THE TRENCHES

A Land of Corruption, a Land of Hope

"Should I roll up my sleeve now?" I asked the nurse. "Uh," she paused, looking up from a tray shimmering with an assortment of syringes and needles, "you should probably roll up both sleeves." And with that she injected me with immunizations for eight of the world's most horrible diseases—thus beginning my journey to Nigeria.

Last fall Zephyr was hired to conduct an air quality analysis in support of a port being constructed in Nigeria. Our main tasks were to set up a network of monitors to establish baseline air quality and to conduct dispersion modeling to predict air quality after construction of the port.

While the modeling analysis presented some unique challenges, it was the monitoring aspect of the project that I found most interesting—specifically, my time in Nigeria as we set up the equipment.

Upon our arrival in Lagos, we were greeted at the airport by our appointed "shepherd" who led us through customs, baggage claim, and took us out to meet our car. As we emerged from the airport, I immediately noticed the plethora of security guards armed with machine guns—not an uncommon site in international travel. While we waited for our car, several of them sauntered up to us and were quite friendly, welcoming us to Nigeria and asking us where we were from.

When our car arrived we bid our airport shepherd friend farewell with a small tip. But before we were even seated in the car, one of the security guards who had been chatting with us simply reached out and took the money from our friend's hand. What's more, our friend didn't protest at all. I had just witnessed a microcosm of life in Nigeria—the person with the gun wins.

Although corruption is widespread, Nigeria, the most populous country in Africa and the seventh most populous in the world, is primed for economic development. With its thriving jungles, miles of undeveloped beaches, and a forest with what is believed to be the world's largest diversity of butterflies, Nigeria could be one of the premier travel destinations in the world. On the cultural side, Nigeria boasts the second-largest movie industry in the world, Nollywood (behind India's Bollywood). Nigeria is also blessed with huge oil reserves in the Delta region and many untapped mineral resources.

People in Nigeria fall into two main camps—the "haves" and the "have nots." During my time there I saw both ends of the socio-economic spectrum. Tremendous poverty was almost always in sight, but every once in a while you'd drive past a colossal man-



sion, high up on a hill beyond mammoth fortified walls with armed guards at the gate.

Having witnessed the corruption and observed the poverty firsthand, I was understandably a bit cynical as a local man approached us the day we carried the high-volume particle sampler out into the field. "All this fellow wants," I thought to myself, "is to know what this thing is so as soon as we leave he can tear it down and sell off the metal." However, I could not have been more wrong.

David got very excited when he learned we were working on an environmental project, because he was going to school to get a degree in meteorology. He was even more excited when he learned I was a meteorologist. As it turns out he and his brother were instrumental to the success of the project, whether it was taking us to a nearby village to buy nails or changing the particulate filters throughout the sampling. I am certain the project would not have gone as smoothly without their help.

During my time in Nigeria, I had several touching conversations with David, which helped give me a new perspective on things. Although he does not have the essentials that we take for granted, such as food and clean water, it was clear that he does have an unquenchable thirst to better himself and his family.

Wanting to somehow thank him for all his help, at the end of the project I gave him a Certificate of Appreciation, a letter of recommendation commending him for his good work, and two used meteorology textbooks. The gratitude that he expressed to me, for what many of us would consider pretty "small" gifts, has

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AN ATTORNEY'S PERSPECTIVE

EPA as PSD Permitting Authority Creates Delays and Harms Texas Economy

Texas applicants needing a Prevention of Significant Deterioration (PSD) greenhouse gas (GHG) permit are in an awkward position — they must undergo two separate permitting processes, one at the Texas Commission on Environmental Quality (TCEQ) to authorize a project's non-GHG emissions and one at EPA to authorize GHG emissions. They must navigate their way around both agencies, pleasing both masters.

At EPA, in addition to satisfying BACT and impacts reviews, applicants are subject to federal reviews or consultations under the Endangered Species Act, Coastal Zone Management Act, National Historical Preservation Act, Magnuson-Stevens Fishery Conservation and Management Act, and Environmental Justice — reviews not required of applicants in states where GHG permits are issued by a state regulatory agency. EPA staff and Texas air applicants are equally inexperienced in performing these reviews; processes and procedures are, out of necessity, being created out of whole cloth. Add to this picture EPA's lack of manpower, and the result is significant backlogs and lengthy application reviews that do not appear to be gaining efficiency.

At TCEQ, applicants and the Agency have to find creative ways to fill permit gaps that arise in the context of a dual permit system. Title V applicants, at least until recently, had no clear procedure in place with the TCEQ to put federal PSD GHG applicable requirements into the state-issued operating permits. Procedures for registering synthetic minors and authorizing minor modifications of sources of GHG emissions are still not formalized. In addition, EPA has announced its intent to grab jurisdiction over non-GHG pollutants where the source is subject to PSD solely because of its GHG emissions and at least one of the non-GHG pollutants is emitted at or above PSD significance levels.

The uncertainty in the process, the delays caused by inexperience, and the challenges in filling permit gaps are all having a major impact on the speed of approval of major projects in Texas. Most importantly, Texas is at risk of losing projects to other states where the permit process is more certain.

To remedy these ills, the Texas Legislature has two bills before it, HB 788 by Wayne Smith and SB 536 by Chuy Hinojosa, that would authorize TCEQ to become the PSD permit authority for sources of GHG emissions in Texas. While these bills are just now making their way through the legislative process, it is hard to imagine anyone taking issue with the principle that TCEQ is by far the preferred permit authority due to its technical expertise and experience in processing air quality permit applications. Both bills currently require TCEQ to develop provisions governing



the transition of applications caught mid-stream in EPA's review process on the date TCEQ takes over the program. Transitioning this authority in the least disruptive manner possible will be essential to the success of this effort.

Knowing the distasteful nature of regulating GHGs in Texas, these bills also provide that if authorization to emit GHGs is no longer required under federal law, the authority for Texas to permit these emissions ceases to exist.

If this legislation passes, TCEQ will have to undergo a rulemaking to revise its air quality program to encompass GHG emissions and obtain EPA's approval of SIP revisions implementing the GHG permitting program. EPA transfer of permit authority to TCEQ would be the final step.

Of the 66 applications filed with EPA since January of 2011, only 12 permits have been issued and 54 remain pending. And, to date, the TCEQ has only issued one Title V permit to incorporate GHG permit requirements. These projects represent over \$30 billion in capital expenditures delayed due to lengthy federal reviews and coordination with incomplete state procedures. Texas businesses are caught in the middle between EPA and Texas over GHG regulation. Action by the Legislature would enable TCEQ to revise its regulations to become the permit authority for Texas sources of GHG emissions. Transfer of this authority would benefit all Texans as it would break the application logjam at EPA, rest jurisdiction over GHG emissions in a single permit authority, and provide long-term economic benefits for the State. ✨

Celina Romero

Duggins Wren Mann & Romero, LLP

News Briefs

national news

President Appoints New EPA Administrator

On March 4, President Obama appointed Gina McCarthy to be the new EPA Administrator, replacing Lisa Jackson who recently resigned. A 25-year veteran of environmental policy and politics, McCarthy has recently been serving as EPA Assistant Administrator for the Office of Air and Radiation. If confirmed by the Senate, she faces issues such as how to control global warming pollution from power plants, dealing with methane leaks from hydraulic fracturing operations, and dealing with a backlog of pollution rules that are required by the Clean Air Act to be updated but have been postponed. For more information, contact Ed Fiesinger at 281.668.7353 or efiesinger@zephyrenv.com.

Supreme Court Refuses to Hear Appeal of Low Court Ruling on SO₂ Standard

On January 22, the U.S. Supreme Court decided not to hear an appeal by Grupo Mexico's SAB Asarco LLC unit of a ruling by the D.C. Circuit Court of Appeals that upheld the 1-hour National Ambient Air Quality Standard (NAAQS) for sulfur dioxide (SO₂) of 75 parts per billion. In its appeal, Asarco had claimed that the D.C. Circuit gave EPA liberty to set needlessly stringent standards rather than those "not lower or higher" than necessary. In response, the D.C. Circuit had stated it lacked jurisdiction to review EPA's rulemaking and that it did not act arbitrarily or unreasonably. For more information, contact Bill Jones at 410.312.7910 or bjones@zephyrenv.com.

EPA Issues Draft Guidance for Modeling Secondarily-Formed Fine Particles

On March 4, EPA provided draft guidance for modeling the effects of secondarily-formed fine particulate matter (PM_{2.5}) due to emissions of nitrogen oxides (NO_x) and SO₂ in NAAQS demonstrations under the Prevention of Significant Deterioration (PSD) permitting program. As part of a tiered approach, EPA recommended that compliance with the PM_{2.5} NAAQS for projects with small quantities of NO_x and SO₂ emissions could be demonstrated by modeling only the primary PM emissions with the AERMOD dispersion model. However, for projects with large amounts of NO_x and/or SO₂ emissions, applicants would be required to demonstrate compliance based on a combination of

primary PM modeling and a secondary PM_{2.5} analysis. The secondary PM_{2.5} analyses could consist of a purely qualitative approach, a hybrid qualitative/quantitative approach, or full, quantitative photochemical grid modeling. For more information, contact David Castro at 512.579.3820 or dcastro@zephyrenv.com.

EPA Amends Portland Cement Air Rules

On February 12, EPA issued final amendments to its Portland Cement hazardous air pollutant and new source performance standards in response to petitions by the Portland Cement Association and to a Court decision by the D.C. Circuit. The final amendments are consistent with those proposed on July 18, 2012 with a few exceptions: aspects of continuous parametric monitoring requirements for particulate matter and total hydrocarbons, and standards for periods of start-up and shutdown for new and existing kilns, have changed. The date existing sources must comply with the amended rules is September 9, 2015, except for open clinker pile requirements, which must be met by February 12, 2014. For more information, contact Roger Brower at 410.312.7907 or rbrower@zephyrenv.com.

EPA Amends Incinerator Air and Solid Waste Fuels Rules

On February 7, EPA amended its Part 60 new source performance standards for commercial and industrial solid waste incinerators (CISWI), establishing effective dates for these air-related standards and providing clarifications to definitions, references, applicability, and compliance issues. In addition, EPA issued final amendments to its Part 241 non-hazardous secondary materials rule, which provides standards and procedures for identifying non-hazardous secondary materials that are a solid waste under the Resource Conservation and Recovery Act when used as fuels or as ingredients in CISWI combustion units. The amendments went into effect on April 8. For more information, contact Betty Moore at 512.879.6622 or bmoore@zephyrenv.com.

Court Vacates and Remands Significant Impact and Monitoring Levels for Fine Particles

In response to a lawsuit filed by the Sierra Club, the D.C. Circuit Court of Appeals, on January 22, vacated and remanded portions of the PSD regulations that address significant impact levels (SILs) and significant monitoring concentrations (SMCs) for PM_{2.5}. EPA is

currently assessing the effects of the ruling on pending air permit applications relying on PM_{2.5} SILs and/or SMCs. In addition, given a statement by the Court that SMCs are not to be used as a de minimis exemption from preconstruction monitoring, EPA is also assessing the impact this decision might have on the use of SMCs for other pollutants. For more information, contact Bill Jones at 410.312.7910 or bjones@zephyrenv.com.

EPA Finalizes Changes to its Hazardous Air Pollutant Rules for Boilers and Heaters

On January 31, EPA published changes to its Subpart DDDDD major source hazardous air pollutant rules for industrial, commercial, or institutional boilers or process heaters, and, on February 1, published its Subpart JJJJJ rules for area sources. These rules, also known as the boiler MACT standards, have broad applicability to a variety of units burning a wide range of fuels. Boilers and process heaters burning natural gas or refinery fuel gas are not subject to numerical emission limits under rules; however, periodic tune-ups would be required for these sources, and existing units would have to conduct a one-time energy assessment. Gas-fired boilers are not subject to any requirements under the area source rule. For more information, contact Edward Rapiere at 512.879.6649 or erapier@zephyrenv.com.

OSHA Advises Industry about Working Safely with Nanomaterials

In January, the Occupational Safety and Health Administration (OSHA) released a new fact sheet describing practices for working safely with nanomaterials — naturally occurring or manufactured materials no larger than 1/1000th of the diameter of a human hair. Engineered nanomaterials are used in the manufacturing of electronic devices, weaponry, insulating materials, and even in the catalytic converters of automobiles. According to OSHA, the health and safety of workers who use nanotechnology may be adversely affected due to exposure to these materials through inhalation, skin contact, or ingestion. The fact sheet provides basic information to workers and employers on the most current understanding of potential hazards associated with this rapidly-developing technology and highlights measures to control exposure to nanomaterials in the workplace. For more information, contact Molly McKenna at 512.579.3837 or mmckenna@zephyrenv.com.

EPA Proposes to Review Adequacy of State Plans for Regulating Startup, Shutdown, and Malfunction Emissions

In response to petitions by the Sierra Club and other parties, EPA proposed, on February 22, to examine the adequacy of the startup, shutdown, and malfunction (SSM) provisions of air rules in 37 states. Specifically, EPA is concerned that the state rules contain provisions that provide for exemption of excess SSM emissions from emissions limitations and are written in a way that preclude EPA enforcement actions against the entity

causing the excess emissions. In its proposal to call in the plans of states for implementing the Clean Air Act, EPA stated that such plans are clearly inadequate to meet the provisions of the Act. For more information, contact Ed Fiesinger at 281.668.7353 or efiesinger@zephyrenv.com.

EPA Proposes New Method to Measure Lead in the Ambient Air

On February 5, EPA published a proposed new federal reference method (FRM) for measuring lead in total suspended particulate matter (TSP). The proposed method is based on the high-volume TSP sampling method coupled with the use of inductively coupled plasma mass spectrometry to analyze the samples. According to EPA, this proposed method is an improvement over the existing FRM because it is more sensitive to detection limits, precision, sample throughput, and extraction efficiency. For more information, contact Bill Jones at 410.312.7910 or bjones@zephyrenv.com.

state news

Court Suspends New Water Permits in Effort to Protect Whooping Cranes

On March 11, the Corpus Christi Division of the U.S. District Court ruled that the Texas Commission on Environmental Quality (TCEQ) failed to manage the waters of the Guadalupe River and is responsible for the deaths of 23 endangered whooping cranes. Subsequently, Court Judge Janis Graham Jack ordered the state to stop granting new water permits on the Guadalupe or San Antonio Rivers until it can prove the permits won't lead to additional crane deaths. Texas has petitioned the Fifth Court of Appeals to stay the ruling, citing its adverse economic impacts. The Guadalupe-Blanco River Authority, the San Antonio River Authority, and the Texas Chemical Council are also expected to appeal. For more information, contact Clay Fischer at 512.879.6629 or cfischer@zephyrenv.com.

TCEQ Issues First Title V Operating Permit Incorporating Greenhouse Gases

On February 28, the TCEQ issued BASF TOTAL Petrochemicals the first Title V Federal Operating Permit in the state to incorporate greenhouse gas (GHG) requirements from a PSD permit. Currently, EPA Region 6 issues GHG PSD permits in Texas. However, with an ongoing lawsuit between Texas and EPA regarding GHG permitting, there has been uncertainty about whether TCEQ would incorporate EPA-issued GHG permits into Title V Operating Permits and if so, whether EPA would object to the Title V permits during their 45-day review and comment period. Companies holding GHG PSD preconstruction permits

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now have an established process for obtaining an operating permit for their facilities. For more information, contact Eric Quiat at 512.579.3823 or equiat@zephyrenv.com.

EPA Proposes to Disapprove Texas Emergency Construction Authorization Rules

On February 5, EPA proposed to disapprove the TCEQ's rules that authorize the use of emergency orders to allow a source, subject to federal air quality new source review (NSR), to start re-construction of facilities damaged due to a catastrophe without first obtaining an NSR permit. EPA states that the NSR program requires public participation and permit issuance prior to construction, whereas the TCEQ emergency order rule allows construction to start before the public has an opportunity to comment. EPA, however, asserted that if local governments have included emergency order programs within their air quality regulations, they can exercise enforcement discretion to allow construction prior to NSR permit issuance as they did with facilities damaged in 2005 by Hurricane Rita and more recently by Superstorm Sandy. For more information, contact Ed Fiesinger at 281.668.7353 or efiesinger@zephyrenv.com.

TCEQ Proposes Oil and Gas Permit by Rule for Maintenance, Startup, and Shutdown Activities

On February 27, TCEQ commissioners approved a proposal to create a new permit by rule (PBR) covering maintenance, startup, and shutdown (MSS) activities at oil and gas facilities, as an alternative to the more burdensome process of securing authorization through the Chapter 116 permitting of MSS emissions. By law, the TCEQ is prohibited from issuing a new PBR with emission limitations unless credible air quality monitoring data are used to support those new emission limits. However, the proposed PBR §106.359 does not impose activity-based or hourly emission limits for MSS activities; rather, it allows for best management practices to be followed and does not require registration. The anticipated PBR adoption date is July 24, 2013. For more information, contact Eric Quiat at 512.579.3823 or equiat@zephyrenv.com.

Pennsylvania Revises General Permit for Oil and Gas Facilities

On February 1, the Pennsylvania Department of Environmental Protection revised and reissued its General Air Permit 5 for natural gas compression and processing facilities. The revisions include several significant changes, including tightened air emissions limits for new gas-fired engines and glycol dehydrators, coverage of gas-fired turbines under the general permit, requirements for equipment leak detection and repair, and revised procedures for establishing a source's synthetic minor status. For more information, contact David Mahler at 410.312.7909 or dmahler@zephyrenv.com.

EPA Proposes SO₂ Air Standard Attainment Designations, Delays Decision on Texas

On February 15, EPA responded to recommendations by states concerning designation of the attainment status of areas with the 2010 NAAQS for SO₂. In the announcement, EPA proposed nonattainment designation, which it intends to finalize in June, for areas for which air monitoring data from 2009-2011 indicate violations of the 2010 SO₂ NAAQS. EPA is deferring its response to state recommendations for designations for other areas and will address those areas later. Although Texas air monitoring indicates no NAAQS violations, EPA is delaying its finalization of the attainment designations for Texas. However, based on earlier EPA comments, it is anticipated that the EPA will designate all areas of Texas as unclassifiable due to a lack of monitoring data. For more information, contact Curtis Harder at 512.879.6643 or charder@zephyrenv.com.

TCEQ Reissues Storm Water General Permit

On February 19, the TCEQ reissued the Texas Pollution Discharge Elimination System Construction General Permit TXR150000 (CGP), which went into effect March 5. Operators of construction sites who anticipate disturbing one or more acres of land as part of construction begun after March 5 must obtain coverage under the reissued CGP before starting construction activities. Construction projects covered under the CGP issued in 2008 must either complete construction and submit a Notice of Termination or obtain coverage under the re-issued CGP by June 3, 2013. For more information, contact Robin Cosgrove at 512.879.6623 or rcosgrove@zephyrenv.com or contact Miranda Briones at 512.879.3957 or mbriones@zephyrenv.com. ✨

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been nothing short of overwhelming. He's back in school now, and hopes to graduate next year.

So, while the project was interesting to me and successful for Zephyr, what I will remember the most is David's positive attitude despite his circumstances, and, above all, our friendship. ✨

Bill Jones
Senior Project Manager

What Will America's Energy Mix Look Like in Five Years?

America's energy mix is in a state of great flux, due, in large part, to the boom in oil and gas production resulting from innovations in hydraulic fracturing technology (see July 2011 edition of *Currents*: "A Fractured Approach to Meeting our Energy Needs"). In essence, these innovations have changed the economics of our energy mix, giving us a plentiful supply of cheap natural gas. This has had an adverse impact on coal mining and power generation from coal – not many years ago, we were reassuring ourselves that "America is the Saudi Arabia of coal" and that we had a plentiful supply of this resource for our future needs.

These days, now we're talking about how "America will be the NEW Saudi Arabia of oil and gas," with America on track to surpass Saudi energy production by 2020 (see "World Energy Outlook 2012" by the International Energy Agency). The same report goes on to say that America could be producing as much energy as it uses by 2035. This is in stark contrast to Europe and Asia, where much higher prices for natural gas promote a continuing reliance on coal. Even climate change-conscious Germany, which imports wood fuel pellets from the United States to meet its carbon neutrality goals, finds itself burning more coal and less natural gas due to the cost disparity between the two fuels.

What about alternative energy sources? As energy prices were spiking in the last decade, the deployment of solar power and, particularly, wind energy was greatly accelerated. Although the use of these sources increased significantly, in the aggregate they still represent less than ten percent of America's energy mix. The economics of these energy sources is tricky, because at least up until now they have relied on government subsidies to be competitive, and lower cost natural gas makes their comparative economics more difficult as well.

After 40 years of hype, it was beginning to seem like waiting for economical solar energy was a mug's game. However, solar power research and development has driven down the cost curve for solar installations to the extent that, in some places where energy is



particularly expensive (like Hawaii), so called "grid parity" has been achieved — that is, energy from unsubsidized solar power installations costs less than "grid power" from more conventional sources. Reportedly, in recent months, more than 70 percent of building permits in Honolulu have been for solar energy installations!

All of this is not to say that solar will render fossil fuels obsolete any time soon. Retrofitting homes with solar panels may require expensive electrical upgrades, and regulations remain in place that limit the percentage of grid capacity that can be comprised of solar power (we do also need power at night, after all). For commercial installations, lengthy interconnection studies have to be performed.

The upshot is that America's energy mix looks very different now than it did five years ago, and chances are good it will look different still five years from now. ☀

Joe Zupan
President

Zephyr is a full-service environmental, health, and safety firm offering consulting, training, and data systems services to clients worldwide. We specialize in air and water quality, waste management and cleanup issues, incident management, natural resources, and workplace and community safety.

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market conditions (the availability of relatively cheap natural gas for power generation has dropped market prices for electricity). The DOE also provided funding for a 270-MW facility near Des Moines, Iowa. However, that project, which also received significant support from municipal utilities in Iowa and nearby states, was terminated in 2011 after eight years of development because of site geological limitations.

One other CAES project of note is the FirstEnergy facility in Norton, Ohio. Project engineering and design have been completed for the initial 268 MW of power generation for the FirstEnergy facility, with potential future generation of more than 2,000 MW.

What about Texas? With its tremendous potential for wind and solar energy development and the right underground geology for storing compressed air, the state recently has seen increased permitting of CAES systems. Air permit applications for three large-scale projects were submitted to EPA in 2012: 317-MW CAES facilities in Anderson County and Matagorda County, and a 270-MW CAES facility in Swisher County. Air emission levels projected for these proposed facilities were such that Prevention of Significant Deterioration permits were required only for emissions of greenhouse gases. The applicants plan to start operating these facilities in 2016.

The environmental impacts of a CAES facility are generally less adverse than those of other power generation sources, although unique subsurface geologic/

hydrologic concerns have to be addressed. According to the Coalition to Advance Renewable Energy through Bulk Storage, a CAES facility, because of its significantly better heat rate, emits about 30 percent less CO₂ than a combined-cycle combustion turbine and about 55 percent less CO₂ than a simple-cycle combustion turbine on a pound per megawatt-hour basis. Water consumption and wastewater discharges at a CAES facility are generally similar to a typical combustion turbine power plant; however, the handling of wastewater generated during the construction phase of a CAES facility can be an issue. Solution mining operations needed to create the capacity for storing compressed air in salt caverns can yield voluminous amounts of saturated brine requiring disposal. And a thorough characterization of subsurface geology and hydrology must be conducted early in the project design phase to assess the potential for subsurface erosion, groundwater aquifer impacts, and seismicity effects.

The energy storage potential of CAES has been recognized for decades, with the continued push for increased renewable energy use keeping the spotlight on the technology. The Electric Power Research Institute estimates that there are suitable underground storage sites across 85 percent of the U.S. Despite some project failures, many people still believe that CAES is the best power storage/generation option, and recent project development activities appear to confirm that belief. ✨

Lou Corio
Senior Scientist