



EXAMPLES OF WSPA MEMBER COMPANY ALTERNATIVE FUELS AND GREENHOUSE GAS EMISSION REDUCTION PROGRAMS AND PROJECTS

WSPA's member companies are voluntarily reducing emissions in low-cost, common-sense ways, developing new fuels and technologies and investing billions of dollars to research and commercialize alternative fuels and technologies.

RENEWABLE ENERGY

- Chevron Corporation and the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) have entered into a collaborative research and development agreement to study and advance technology to produce liquid transportation fuels using algae.
- Shell's wind farm near Palm Springs displaces 85,000 tons of carbon dioxide every year and meets the electricity needs of 11,000 households. Shell's 980 watt solar electric power system at the Semitropic Water Storage District in Wasco, California, saves 1,729,000 kw hours per year and avoids 1,763,000 pounds of CO₂ annually. Shell is also investing in advanced biofuel processing technologies.
- BP Solar has steadily increased its stake in renewable energy, ending 2008 with a 213 megawatt capacity in solar. In a joint venture with Tata Power, plans are underway to increase the coalition's solar capacity in India to 300 megawatts, with a target of becoming a \$1 billion project by 2012. BP also is focused on the development of wind farms at existing BP refineries and petrochemical sites and is investing in research and development of advanced biofuels.
- Chevron has developed hundreds of projects to enhance energy efficiency for education, government, and business customers in the United States. Examples of their solar energy projects include the Contra Costa Community College District in California, which is now the largest solar college in North America, using a 3.2-megawatt system of photovoltaic panels. The new solar program is expected to save the district more than \$70 million in energy costs over the next 25 years
- Valero recently purchased seven ethanol plants in an effort to advance the company's stake in the biofuel industry. The plants will provide Valero with 780 million gallons of ethanol production capacity.



CONSERVATION AND ENERGY EFFICIENCY

Conservation and the efficient use of energy are critically important because they help reduce growth in demand to keep energy affordable and reduce greenhouse gas emissions. WSPA companies are doing their share to conserve energy.

- Energy efficiency measures at BP helped reduce operational greenhouse gas emissions by 3.5 million metric tons from 2005-2007. BP's cogeneration project at its Texas City refinery realized a 250,000 ton reduction in greenhouse gas emissions in its first 12 months of full operations.
- Shell reduced its greenhouse gas emissions by seven million tons in 2008 from the previous year and 30 percent below 1990 levels. Shell's Oil Products and Chemicals businesses committed to undertake energy efficiency projects at their 40 major facilities. In Nigeria, for example, refinery operations run by Shell and partners have invested more than \$3 billion and have reduced gas flare volumes by almost a third already. Shell's most recent project, a high efficiency cogeneration plant in Belgium, opened in March of 2009. In addition to generating 125 megawatts, the new plant will reduce emissions by approximately 200,000 tons per year, the equivalent of removing 90,000 cars from Europe.
- Since 1986, Occidental has invested in the construction of several highly efficient cogeneration facilities to produce electric power and steam. These investments have doubled energy efficiency over traditional power production while reducing carbon dioxide emissions by almost four million metric tons at full utilization.
- ExxonMobil affiliate, TonenGeneral, has broken ground on a new facility to manufacture lithium-ion batteries that will help improve energy efficiency and affordability of next generation hybrid and electric vehicles. The plant will use TonenGeneral's advanced polymer and process technologies, and a new technology platform from ExxonMobil Chemical, to produce the separator films. The plant is expected to start operations in late 2009.
- Tesoro installed two state-of-the-art flare gas compressors at its Golden Eagle Refinery in Martinez. This equipment takes flare gases – hydrogen, nitrogen, methane and other hydrocarbons – compresses them and returns them to the refinery for use as fuel. This project reduced flaring by 90 percent, which in turn reduced flare emissions by 94 percent. At its Salt Lake City Refinery, Tesoro's cogeneration operation (using natural gas to generate both electricity and steam), reduces emissions at that facility by more than 500 tons each year.
- Aera's cogeneration facility in the San Joaquin Valley combines electric power production with oil production. It produces 315 megawatts of electricity, enough power for 160,000 households while reducing greenhouse gas emissions.



- ConocoPhillips cogeneration plants in Europe and the United States save energy and reduce emissions. Its newest cogeneration plant uses up to 20 percent less energy while cutting carbon dioxide emissions by three million tons a year.



- Chevron participates in cogeneration projects that, collectively, produce enough electricity to power more than one million homes. For example, two cogeneration facilities in Kern County, California, with high generating efficiencies, provide 600 megawatts of electricity while emitting substantially less carbon dioxide than conventional gas-fired simple-cycle power plants. At the U.S. Postal Service's Processing and Distribution Center in West Sacramento, California, Chevron's Energy Solutions Division completed a number of energy-efficient upgrades, including the nation's largest nonmilitary federal solar power installation. These improvements are expected to reduce the facility's power use by more than one third.

IMPROVING THE EFFICIENCY OF EXISTING TECHNOLOGY

Continuous progress in reducing smog-forming emissions from the internal combustion engine has been a phenomenal success story.

- California's cleaner-burning gasoline reduced smog-forming and carbon monoxide emissions by one billion pounds a year, the equivalent of taking 3.5 million cars off the road.
- ExxonMobil in partnership with Toyota and others is exploring new approaches to traditional internal combustion engine (ICE) technology. Better understanding of fuel chemistry and combustion could lead to 30 percent better fuel efficiency and a corresponding reduction in smog-causing emissions and carbon dioxide.

HYDROGEN TECHNOLOGY

Hydrogen is a chemical element that carries energy and can be stored in either liquid or gaseous form. When combined with hydrogen fuel cells it can generate electricity with far fewer emissions than other means of production.

- Several WSPA members including BP, Chevron and Shell are members of the California Fuel Cell Partnership, a private-public consortium to overcome the difficult technological challenges in making hydrogen fuel cells.
- BP subsidiary Hydrogen Energy California has applied for permits to build the country's first industrial-scale low carbon power plant with



carbon capture and sequestration (CCS). The proposed Kern County facility will produce hydrogen fuel from petroleum coke (a by-product of refining) and coal using integrated gasification combined cycle (IGCC) technology. The hydrogen will be used to generate around 400 MW of electricity – sufficient to power 150,000 local homes. Over two million tons of CO₂ will be captured and stored in nearby underground geological formations.

- ConocoPhillips is working with other private companies in California to develop a hydrogen infrastructure in California by testing multiple approaches to producing hydrogen and providing infrastructure at 24 fueling stations throughout the state.



- Chevron is working to make hydrogen energy an attainable resource for the public. In Southern California Chevron has developed a hydrogen station that uses water electrolysis to convert city water into purified hydrogen that can be used for energy. The company is also collaborating with AC Transit in Oakland to design and build a state-of-the-art fueling station for hydrogen fuel cell and hybrid-electric buses and cars. The company's most recent achievement was the installation of

the first commercially operating fuel cell power plant in the San Francisco Bay Area. The fuel cell provides continuous high-quality power 24 hours a day with technologies that benefit the environment and are efficient.

PROMISING NEW TECHNOLOGIES

- **Coal Gasification:** This process converts coke or coal synthetic gas to hydrogen which in turn can be used as a fuel for electric power plants. ConocoPhillips demonstrated this technology on the Wabash River in Indiana where it succeeded in generating electricity which produced emissions far below U.S. Clean Air Act standards with negligible particulate matter levels and a 20 percent reduction in carbon dioxide.
- **Carbon Sequestration:** Capturing and “sequestering” carbon dioxide in geologic formations has the potential to mitigate CO₂ emissions associated with combustion of fossil fuel resources. ConocoPhillips has joined the Carbon Storage Foundation with the goal of safely storing carbon dioxide below the earth's surface to prevent atmospheric damages.

INDUSTRY RESEARCH

- BP and The California Institute of Technology have teamed up in a multi-million dollar research program that could open the door to a radical new way of producing solar cells, making the cost of solar electricity more competitive and increasing current efficiency levels. BP also announced it will partner with UC Berkeley and the Berkeley National Laboratory to establish a new Energy Biosciences Institute.

- The mission of The Global Climate and Energy Project (GCEP) at Stanford University is to conduct fundamental research on technologies that will permit the development of global energy systems with significantly lower greenhouse gas emissions. It receives financial support from ExxonMobil, General Electric, Schlumberger, and Toyota.
- The CO₂ Capture Project is a global collaboration formed to research and develop technology to reduce greenhouse gas emissions. Its members include BP, Chevron, ConocoPhillips, Shell, the U.S. Department of Energy and the European Union.
- Chevron has announced plans to set up a \$20 million center for energy efficiency and renewables in Qatar in the Middle East. The Center for Sustainable Energy Efficiency will be a partnership with the Qatar Science & Technology Park to focus on the development of lighting and cooling technologies that work in the extreme climate of the Middle East. When the center opens in 2009, research will look at developing renewable energy sources such as solar power in the region, while utilizing Chevron's existing expertise in the field for support.
- Occidental has partnered with the U.S. Environmental Protection Agency through its Star program to evaluate, implement and report on cost-effective programs to reduce methane gas emissions.
- Chevron has formed several research alliances within the industry, universities, national laboratories, and government to develop the breakthroughs necessary to bring nonfood biofuels to the community. Chevron and Weyerhaeuser have united to research and develop technology to transform wood fiber and other nonfood sources of cellulose into biofuels for cars and trucks. Chevron's partnership with the University of California at Davis is working to develop biofuels from agricultural waste and other resources that would not raise food crop demands.
- Shell and Dutch energy company Essent are joining forces to explore the feasibility of a 1,000 MW low-carbon power plant in southwest Netherlands. The plant, which would combine a high-efficiency gasifier with a power generation plant, would capture and store most of the CO₂ produced. Gasification is a potentially cleaner way to use fossil fuels, because it is easier to capture CO₂ than from conventional fossil fuel powered plants. In the process, coal and solid biomass is gasified to produce synthetic gas, which is then used to make hydrogen. This in turn is used to drive turbines to generate electricity.

