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Energy Quarterly

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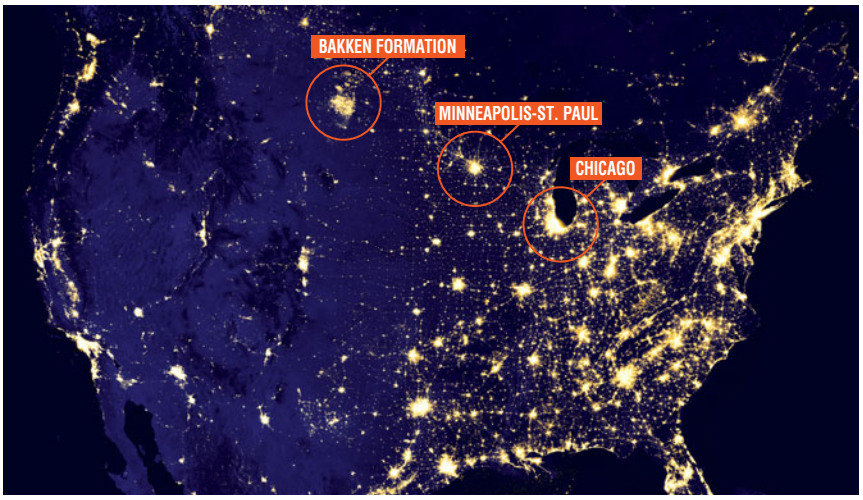

Editorial image: NASA satellite image shows how the gas being burned off at the Bakken oil field in North Dakota is almost as bright as the light emitted from major US cities such as Minneapolis-St. Paul and Chicago.[2] Credit: NASA.

Energy Sector title image: These turbine blades were part of the first successful test of a rotating ceramic-matrix composite part. They were designed for GE's adaptive cycle engine, which is under development for military aircraft. Courtesy of GE Aviation.

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MRS Bulletin

Don't waste the waste

The United States, Canada, and Mexico are now being called the "New Middle East" because of their huge production of oil and gas from both conventional and shale sources.[1] This new hydrocarbon production produces two waste materials in large quantities: flare natural gas and tars. The gas is typically burned away in flares because it is cheaper to burn than to liquefy and sell. A recent NASA study revealed that space stations flying over Siberia reported thousands of flaring oil wells from conventional oil wells, burning as much energy as the East Coast of the United States uses for travel every day. The same phenomenon has been reported in the western states of the United States.[2]

Flare gas is typically comprised of approximately 50% methane and 50% CO_2. Catalytic reforming of methane with CO_2 is possible using catalytic materials producing valuable hydrocarbons that are liquid at room temperature. However, this reaction occurs at temperatures near 700°C. Thus, the cost of implementing this process in petroleum fields is too high. "Flare quenching" methods are now being developed using novel catalytic materials for the reforming using solar power to convert the waste to useful products.[3]

In addition, refineries that produce heavy crudes also produce large quantities of "heavy bottoms" that are used to make "road tars." These heavy bottoms contain molecules called asphaltenes. Under moderate conditions, novel catalytic materials can destroy the asphaltenes and remove sulfur and nitrogen. Interestingly, novel materials can be generated during this process. Indeed, a solar cell made with asphaltenes has been reported.[4] Several more interesting materials made from "waste asphaltenes" are anticipated to be reported in the future. Thus, there are many opportunities to use this so-called waste from oil and gas production using novel catalysts; however, extensive materials research is needed to take advantage of these opportunities.

Russell R. Chianelli

1. M.A. O'Grady, "The North American Gusher," *Wall Street Journal* (December 9, 2012).
2. S. Tomlinson, "What a Waste!," *Daily Mail* (2013), available at http://www.dailymail.co.uk/news/article-2269517.
3. R. Chianelli, B. Torres, "Photochemical Processes and Compositions for Methane Reforming Using Transition Metal Chalcogenide Photocatalysts," US Patent 0239469 (September 19, 2013).
4. R. Chianelli, K. Castillo, V. Gupta, A.M. Qudah, B. Torres, R.E. Abujnah, "Asphaltene Based Photovoltaic Devices," US Patent 12/833,488 (March 5, 2013).

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