GEOCHEMISTRY FOR POSITIVE TRANSITION

Why DIG is excited about energy in the 21st century

BY MICHAEL P. DOLAN

As I write this blog, we are approaching the 18th anniversary of Dolan Integration Group. This is an important milestone because at 18 years old, you are afforded the right to vote in the USA. While the DIG can't vote, there are always important geochemical views to share with our clients. We are proud that we have formulated these views and done it in an era of incredible technological breakthroughs in the subsurface geological sciences and engineering. We feel that we have always added to the dialogue and have even had a few breakthroughs in technologies ourselves.

People often ask how we survived this fun and exciting rollercoaster ride for 18 years. Versatility, athleticism, and an organic growth strategy are often discussed but there is one value that surpasses all: integrity. Since the beginning of this company, we have emphasized our written core principles to those who work here at DIG and those that we work with in the energy industry.

Operational Integrity: We will conduct ourselves professionally and at the highest level of integrity. Our success depends upon this principle.

Technical Integrity – The products that we provide our clientele with are always to be considered at the highest levels of technical and scientific merit. Technical quality is our trademark.

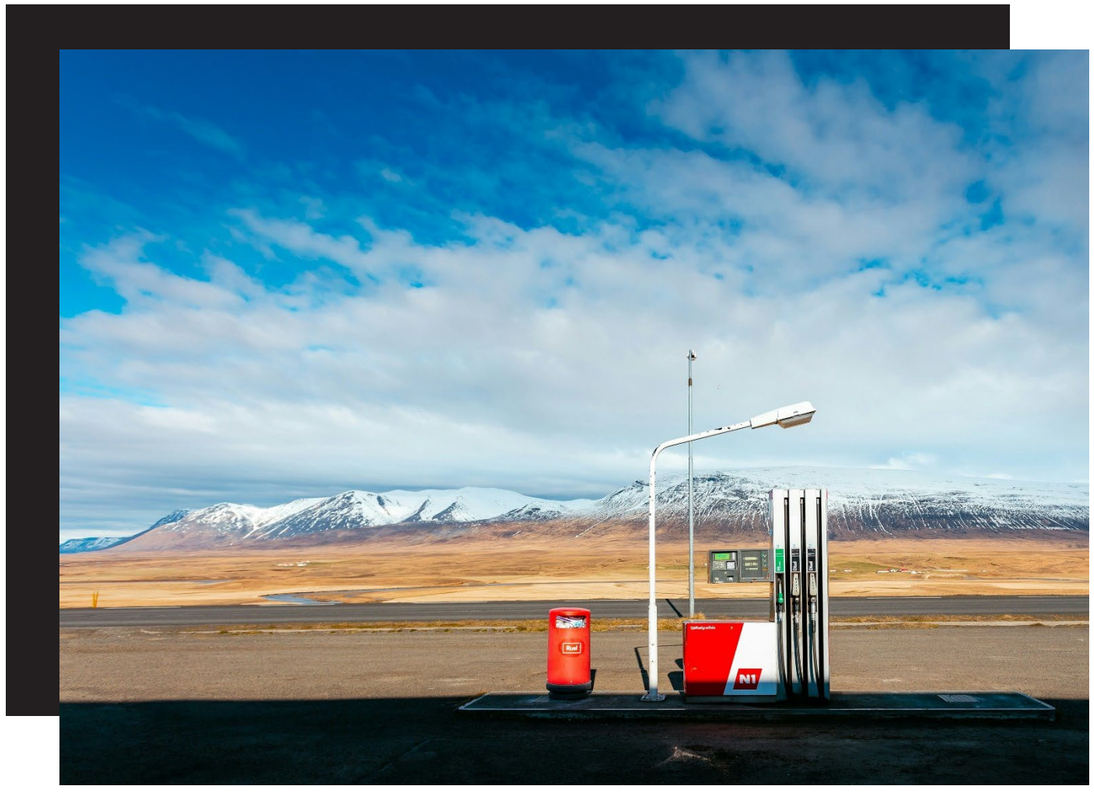
Personal Integrity – We will conduct ourselves to the highest ethical standard. If we serve our clients in this manner, our own success is assured.

When you use these core principles as a foundation for a business, you will position your company to deal honestly and openly with your clientele. DIG is now operating in one of the most exciting times in its short history. Global hydrocarbon energy demand has been increasing with a growing global population.

Alternative energy demand has also been growing exponentially. The development of low-carbon energy sources is important for satisfying that demand and reducing warming gases in our atmosphere.

The federal government might urge the citizenry to personally conserve energy, but the shifting energy landscape is a bit more complex than switching off your LED light while you are using a high-demand energy hog AI chatbot to finish a term paper that is due in the morning.

The energy demand numbers are staggering in our shifting energy landscape and growing population. DIG would like to debunk a few myths that we are sometimes told to shift the energy landscape faster. From a subsurface geochemical perspective, there are many myths which may only be sorted out through open inquiry and scientific integrity.



Kindling the Next Fuel Revolution

When I first started in the energy industry, I formulated an idea about the evolution of fuel. Not the geohistory of fossil fuels—that is what I do for a living. Humans use energy but so do most living organisms. I was particularly interested in the history of staying warm or cooking up food—that kind of thing. Turns out that Richard Leakey, the famed paleoanthropologist speculated that, about two million years ago, Homo Erectus might have rubbed two sticks together to make fire.

This would be an important day for human fuels. Charcoal, which is still used in our WeberTM grills today, is 85 to 98 percent carbon and has been used since 6000 BCE to smelt metals. Coal provided the derivation of coke, which is mainly carbon, after we chopped down all the nearby forests in the 18th century. Coal's first use as a fuel was recorded in 1000 BCE in China.

Then thousands of years later, in 1698, the steam engine was developed to do mechanical work. Coal was the main fuel for the steam engine and the industrial revolution followed. Coal became king. Great Britain's Secretary of the Navy, Winston Churchill, instituted the fuel shift for the Royal Navy from coal to petroleum in the early part of the 19th century.

Not only did the world start to stockpile liquid fuels (petroleum) for national defense, but the internal combustion engine (ICE) for use in the automobile was starting to hit its stride. Natural gas was a part of all these transitional fuel processes and can be talked about anecdotally throughout human history to its current role as a transitional fuel as we move toward low carbon sources of fuel.

As a geochemist, I view this historical transition with a spotlight on carbon and hydrogen—humanity's fuels had progressively higher hydrogen-to-carbon ratios. The limit of that progression is the methane molecule. That is, 4 hydrogen atoms to every 1 carbon atom.

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Well, it doesn't get better than that for hydrocarbons (Check the etymology of that word: hydrocarbon). Unfortunately, methane is a greenhouse gas. Let's drop the carbon molecule altogether and our next transitional fuel would be predicted to be hydrogen gas, or diatomic hydrogen—the universe's smallest known molecule.

Human civilization will continue to transition its fuel and behavioral economics (thanks, Kahneman and Tversky) will guide the choices. Elon Musk might insist that we skip the diatomic molecule that composes hydrogen gas and go straight to electrons, but current infrastructure systems might get in the way.

Why did Hertz car rental end its experiment in renting electric vehicles (EVs)? We can argue this topic until the cows come home. Personally, however, if I go on a trip and I don't know where I can charge my vehicle with electrons, I choose the old-fashioned gas-powered ICE that can be "charged" with gasoline on many street corners. This decision may be based on reality, or a matter of perception only, depending on where I go on my trip.

In defense of Hertz, car renters don't treat the rental like their own vehicle, and maintenance and collision costs for EVs are much higher than that of ICEs. But I go with what I know. John D. Rockefeller thought long and hard about infrastructure and helped the USA to develop antitrust laws and institute the FTC. This is a topic for another day.

I did not start this fuel transition; it started the day that Homo Erectus first rubbed two sticks together and sparked a human trend. I happen to exist at a time when a transition will occur… again. As a subsurface scientist, I know where to find fossil fuels. But the global demand is now insisting that I find hydrogen gas and, while I am at it, dispose of the carbon dioxide that is impacting the atmosphere. As a geochemist, I am uniquely qualified to support this effort.

As a Homo Sapiens, the wise (modern) human, this is the most important technologic transition I have ever been involved with, and there have been a few. I am glad that DIG can support these efforts.

Proven Technologies Can Help

There are many technical challenges that DIG will support.

Carbon Capture & Storage (CCS) requires that a baseline of near and deep subsurface gases is known prior to injection. CCS may require ongoing monitoring to assure competency of the infrastructure. Geologic storage of anthropogenic CO2 will be monitored before, during and long after injection has ceased. DIG's experience with subsurface geochemical monitoring in upstream and midstream oil and gas provides a knowledge base that is heavily leveraged to support designers of CCS systems.

Both the subsurface and atmospheric monitoring of CCS will provide important components of assuring integrity of the system.

In 2017, the National Energy Technology Laboratory (NETL) published a Best Practice Manual (BPM) for the monitoring, verification, and accounting for geologic storage projects. This manual reveals the evolving nature of monitoring technology involved in CCS and provides a critical roadmap for the importance of continued development of these technologies.

DIG employs proven technology that has been employed to monitor well integrity during oil and gas operations.

DIG seeks to dovetail these analytical techniques directly to CCS front-end engineering design (FEED) projects. Using peer-reviewed, established technologies provides immediate cost-reduction needed to implement the designs within the economic constraints of the current energy environment.

Geologic hydrogen that formed and accumulated in the subsurface is an analog for the petroleum system. It has also been deemed "gold" hydrogen. In other words, you don't manufacture gold hydrogen, you mine it.

Tell a geologist that he or she will start exploring again and watch closely as the excitement grows in the individual geologist. Early in my career, I was involved in frontier exploration for hydrocarbons. Frontier exploration provides multiple components in workflows developed from trial and error. This work process development coincides with the history of oil and gas exploration. Subsurface maps generated at the regional scale are critical to successful de-risking.

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Applying the techniques and workflows developed for oil and gas exploration toward risk assessment of renewable and geologic hydrogen energy can provide the efficiency of resources that were unknown to early oil and gas exploration geologists.

Developing a web-based GIS (Geographic Information Systems) tool for viewing, interpreting, and communicating maps and data that support renewable systems will provide efficiency not available to oil and gas exploration geologists.

Frontier exploration for effective petroleum systems in unconventional shale plays meant using all the available data to de-risk the shale play. The oil and gas industry was much more successful, and in a much shorter period, during the shale boom than it was the first time around in conventional accumulation exploration.

This success occurred largely because frontier exploration often involved tremendous amounts of existing datasets. Many of these data sets already exist and can be re-formatted. This is what is most exciting about the developing exploration of gold hydrogen.

This is an exciting time to be a subsurface geochemist, geologist, and engineer. I am so proud of the work that the DIG teams have provided in the first 18 years of our company. I am especially proud of the relationships that I have forged to solve complex problems in our industry. Can you imagine how excited I am for the future? Go DIG!