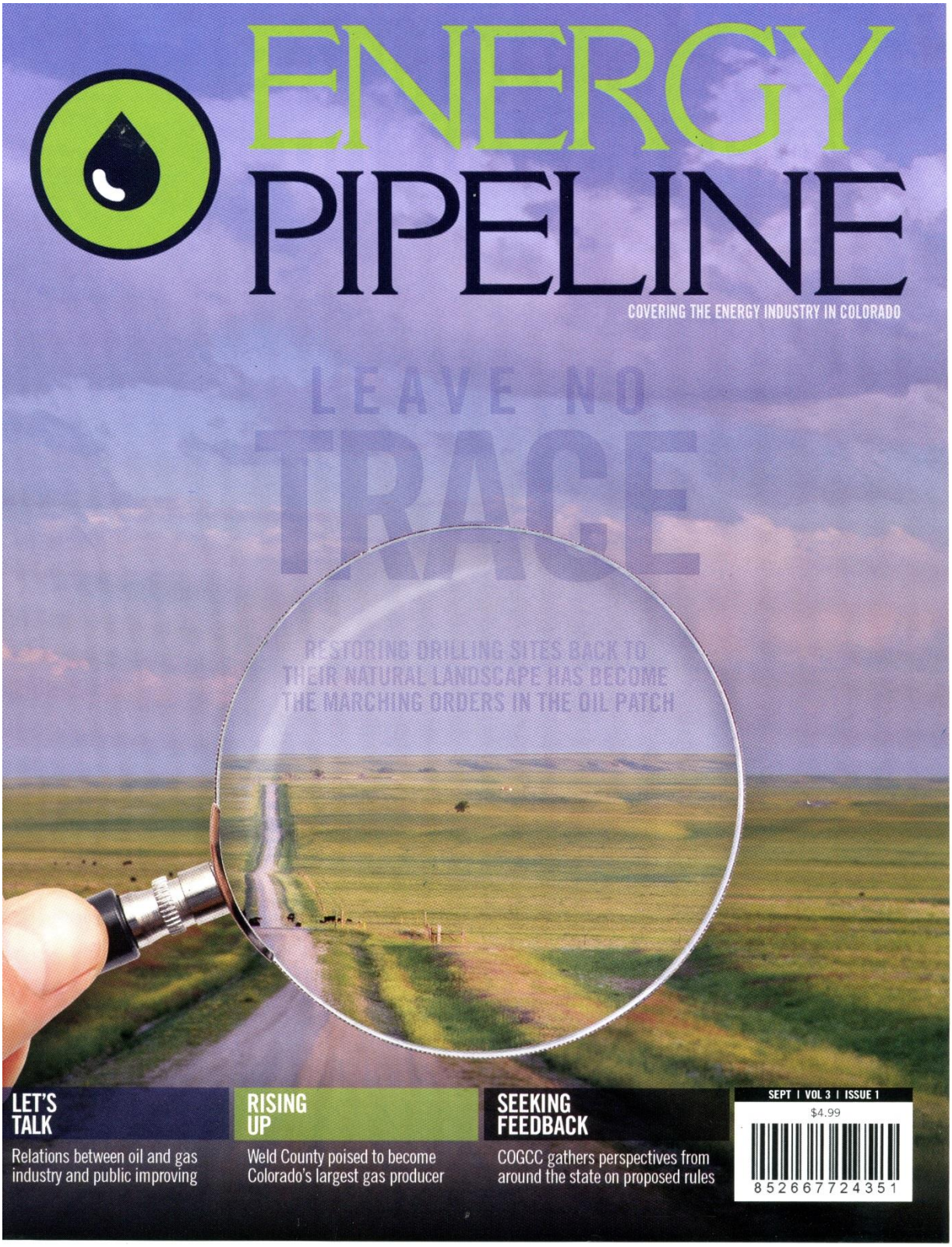
ENERGY
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RESTORING DRILLING SITES BACK TO THEIR NATURAL LANDSCAPE HAS BECOME THE MARCHING ORDERS IN THE OIL PATCH
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TECH TALK

INTERNET OF THINGS (IOT) - THE RISE OF EMBEDDED INTELLIGENCE

BY GARY BEERS • FOR ENERGY PIPELINE

For over 50 years, **GARY BEERS**, has worked in numerous fields of environmental science as a consultant, regulator and educator. This career included senior management position with major consulting, nonprofit and public organizations. He has founded several successful firms to capture emerging resource management markets. One of his latest ventures, EnviroScienceINFO, provides content for public media.

ONLY A SMALL PORTION of the Internet of Things (IoT) is experienced as we use an increasing array of consumer-facing smart devices: smart phones and tablets, Fitbits, remote-controlled household appliances, smart watches, desktop/ laptop computers, and other "brilliant" devices. There is a much larger, industrial portion of the IoT consisting of physical objects with embedded sensors communicating through the cloud with each other and with computers. During the past decade, business and governmental operations have begun to implement massive networks of these objects which share information on their physical state. This "embedded intelligence" is driving today's most important technological advances in commerce.

20 BILLION SMART DEVICES

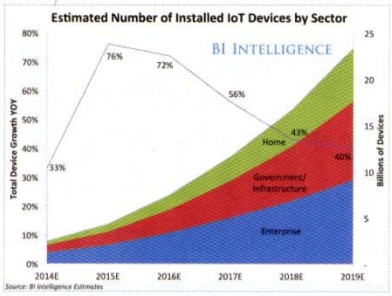
In the next five years, the number of installed IoT devices is projected to increase by over 20 billion. As shown in Graphic 1, approximately 75 percent of these devices (15 billion) will be placed in infrastructure and industrial services.

HOW BUSINESS EFFICIENCIES CHANGE

Why is business pursuing increasing, widespread use of smart devices? The simple answer is - substantial improvements in two types of efficiency. The outcome of profits and savings from IoT implementation is predicted to be at least $19 trillion.

One obvious example of efficiency is the improved uses of resources in business processes. Internet-based scheduling of energy usage, workers with difference skills, robotics, and supplies can generate substantial cost savings, for example: oil and gas ($ 90 billion); power ($65 billion), healthcare ($ 61 billion), aviation ($30 billion); and rail ($27 billion).

A less obvious example of efficiency is realized through "predictive analytics" which is based on "real-time" transmission of information from a sensor embedded in a machine part that impaired performance or failure is expected. Through the industry's internet, the needed new part can be ordered and delivered to the specific location and be available for replacement before failure is experienced. As an example, Union Pacific - America's largest railroad company - has wired locomotives with sensors that monitor parts with internet connections to algorithms that predict when a component may break down. Enormous savings are realized when interruptions due to part



GRAPHIC 1

failure and replacement/repair are minimized. The manager of General Electric's Complex Systems Engineering Laboratory recently said, the internet is no longer just about email, e-commerce, and Twitter. We are at an inflection point, the next wave of productivity will connect brilliant machines and people with actionable insight.

WHAT DOES AN IOT LOOK LIKE?

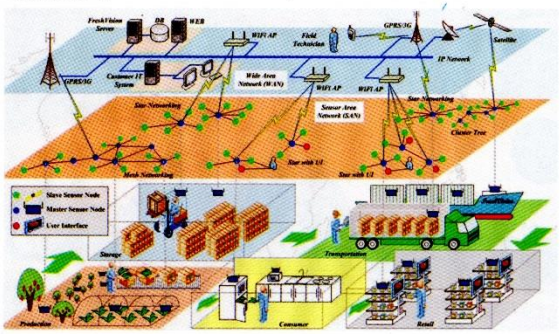
In January 2014, China's vice minister of agriculture announced the launch of regional pilot "Internet of Things Agriculture Projects." The graphic view of the design of the system for this regional pilot (Graphic 2) is reproduced from Dim Sums (a Chinese blog on Rural China Economics and Politics). This view displays the embedded sensors and uses of local and cloud communications.

OIL AND GAS OPERATIONS

The capability of the IoT is widely recognized and implemented by oil and gas industries. A few instances are:

- Intelligent Pipeline Solution (GE Software) serves to harvest data from sensors installed along a 15,000-mile gas pipeline and equipment in the eastern region of the U.S. and synchronizes this information with external data sources to provide detailed analytics and risk assessment from key points of the pipeline system. GE official says, The goal is to help pipeline operators make proactive rather than reactive decisions.

GRAPHIC 2



- Smart Blowout Preventer (BOP) sits on sea floor, and internal sensors transmit data, via Internet, on operational and wear status of components. A GE Oil and Gas official says, "We need to move from the 'break-fix' model to a predictive maintenance model. What if you have a technology gathering BOP data so that the next time you pull it out you know exactly what needs to be replaced and have the replacement parts available on the drilling rig? It costs between $10 million and $16 million to surface a blowout preventer. Predictive maintenance could save drilling companies millions in unplanned downtime. Telling a customer what to fix after it has failed is relatively easy, telling them to fix something before it costs them money is the magic.

BIG DATA, BIG CONCERNS

The IoT is creating new, growing concerns about the storage of enormous amounts of electronic data in clouds, how these data can be re-assembled into new information, and who has accessibility to these data. General materials providing a layman's introduction to these concerns include:

- "Big Data: Seizing Opportunities, Preserving Values. May 2014, Executive Office of the President.
- "Internet of Things - Privacy & Security in a Connected World". January 2015, FTC Staff Report.
- "The Connected World: Examing the Internet of Things. February 2015, Congressional Internet of Things Caucus, Senate Committee on Commerce Science, and Transportation.

Finally, there is an emerging, salient concern about "embedded intelligence" that requires urgent attention with regulation. Self-reporting components of machinery certainly contribute information leading to cost-savings and more efficient business operations. However, inappropriate situations may occur where information unrelated to the intended performance of the component is collected and used for a separate purpose, without the knowledge of the industrial purchaser of the component.