



The 'Resource Factory':

Converting Resources to Reserves to Production

Oil and gas resources are a measure of our company's potential; reserves, production and earnings are the usual measures of our company's true worth.

June 2008 Issue

[The 'Resource Factory'](#)

[Moving Experience](#)

Also in This Issue



[HOW IT WORKS: Pigs: Sentinels of Energy's Underworld](#)



[OUR COMMUNITIES: Engineers Donate Skills to Improve Lives](#)



[LETTERS TO THE EDITOR](#)



The ‘Resource Factory’: Converting Resources to Reserves to Production

*Oil and gas resources are a
measure of our company’s
potential; reserves, production*

*and earnings are the usual measures of our company’s true
worth.*

In 2004, beneath 7,000 feet (2234 m) of water, 20,000 feet (8839 m) below the seabed, Chevron discovered oil in the Jack No. 1 exploration well in the U.S. Gulf of Mexico. Two years later, at Jack No. 2, a record breaking production test unmasked a potential resource by proving that the deepwater lower tertiary rock strata could flow oil at significant rates. Industry applauded the well test and recognized the potential of this new deepwater trend.

Once again, the machinery of Chevron’s “resource factory” began to turn.

The resource factory is Chevron’s term for the process of transforming hydrocarbon exploration opportunities into resources, reserves and ultimately production. Exploration and acquisition are at the “entrance” to the factory – crude oil and natural gas resources are discovered but the likelihood of recovery and commercialization are uncertain.

In the factory, Chevron’s earth science, drilling and completion, reservoir management, facilities design, project management, and operational expertise transform resources to reserves. At the factory exit production from the proved developed reserves base fill company pipelines and tanks with oil and gas.

With one huge test – drilling in deep water and through miles of rock – behind them, the Jack team faced a new challenge: How to turn an apparently enormous prospect into a tangible asset, a new oil field that will increase Chevron’s value.

“Moving resources to proved reserves and to production is closely associated with how we’re valued by our investors,” says Upstream Executive Vice President George Kirkland. “Our business is about moving barrels to production, which translates into earnings. If we don’t replace our reserves, we’ll simply produce ourselves out of business.”

We monitor the effectiveness of our factory through the use of a reserves and resource classification system that is widely used throughout the industry and endorsed by recognized professional industry associations, such as the Society of Petroleum Engineers, World Petroleum Congress and the American Association of Petroleum Geologists.

Our 6P-system classifies discovered resources into three categories of proved (P1), probable (P2) and possible (P3) reserves and three categories of contingent resource (P4 - P6). “The classification system reflects the economic, regulatory and technical uncertainties we confront in the current business environment as we make decisions about commercializing projects,” explains Mike Allison, general manager of Reservoir Management. “When we do our reservoir management job well, we get the outcome we

expect, and more of our resources become reserves and ultimately production.”

The Big Three Challenges

Hydrocarbon discoveries that cannot justify commercial development remain classified as a P4, P5 or P6 resource. As these resources move through the resource factory, technical, governmental and market factors can impede their progress.

The production test at Jack No. 2 is one good example of the types of technical challenges Chevron is tackling when moving resources to reserves in the energy world today. Not only is the Jack prospect very deep with extremely high pressures and temperatures, but it’s also located 175 miles (282 km) offshore. By the time this 5-mile-deep (8 km) well test was completed, Chevron had accomplished more than half a dozen record-setting feats to demonstrate that huge volumes of oil would flow from Jack’s ultra-deep field.



The deepwater drilling rig, *Cajun Express*, conducts the Jack No. 2 well test in the Gulf of Mexico.

“It was amazing to watch the records fall. The team was extraordinarily well prepared and pushed the envelope on so many fronts,” said Gary Luquette, president of Chevron North America Exploration and Production (CNAEP). “When you conduct a test safely and without any environmental incident, you get the right outcome the right way.” Added Steve Thurston, vice president of deepwater exploration projects for CNAEP: “The exploration and eventual development of the Wilcox play in deepwater is going to require a lot of firsts. The Jack well test is just one of the firsts.”

Government regulations are another challenge that can slow the resources to reserves process. Regulatory approval processes for energy projects are often cumbersome. It is not unusual for projects to remain in the P4, P5 and P6 resource classifications for years while Chevron negotiates approvals or obtains permits and licenses. Until appropriate government approvals are granted, projects with enormous commercial potential can be stalled in the resource factory.

“Movement of resources to reserves is a measure of our success in monetizing our resources,”

– George Kirkland.

Business environment uncertainties are a third challenge in the factory. Managers face challenges sourcing services and supplies in today’s competitive market. There is also the huge demand on human resources. “The shortage of human and other resources in our industry today sometimes delays commercialization decisions,” explains Allison. “If we don’t have qualified contractors for a project, this may slow the movement of resources through the resource factory.”

Surmounting these technical, governmental and market challenges is not easy, but Chevron’s project management teams have the skills and leading-edge technology to do so.

“We have the most talented people in the industry,” says Ali Moshiri, president of Africa and Latin America Exploration and Production. “This is vitally important, because we must excel at both project and reservoir management in order to move resources to reserves. If we don’t do this, our assets are just sitting there without being monetized.”

Steps to Production

As resources become reserves, they are assigned a P3, P2 or P1 classification. They move from P3 to P1 as Chevron becomes more technically certain that the barrels will be produced. P3 reserves - also called possible reserves - are estimated to have a 10 to 50 percent chance of recovery. P2, or probable reserves, have a 50 to 90 percent likelihood of being converted into production.

P1, also known as proved reserves, are divided into two sub-categories: proved undeveloped or proved developed reserves.

Chevron’s proved developed reserves represent the oil and gas volumes we estimate will be recovered from existing wells using existing equipment and familiar operating methods. Proved reserves have a minimum of a 90 percent likelihood of being recovered, but the certainty of this is even higher with the proved developed reserves.

“Movement of resources to reserves is a measure of our success in monetizing our resources,” adds Kirkland. “Our P1 subsurface assets are either proved developed or proved undeveloped reserves. We start generating income when we deliver proved developed reserves.”

Because P1 reserves are a measure of Chevron’s long-term financial health, they have to be quantified and reported to the U.S. Securities Exchange Commission (SEC). “In the resource factory, Chevron has about a 62 billion-oil-equivalent-barrel ‘unrisked’ (6P) resource base. Of that base, only our P1 reserves, which equal about 10.8 billion barrels, have minimal appreciable risk,” explains Jeff Tenzer, manager of Corporate Reserves at Chevron. “Not all projects will go forward. As the work matures, some projects fall out of the portfolio for technical and commercial reasons.”

The Factory Inventory

Evaluating and quantifying Chevron’s P1 reserves for compliance with SEC regulations starts with technical teams in the business units throughout the year. “‘Proved’ is a very special category of reserves,” continues Tenzer, adding, “Chevron’s track record of compliance with SEC regulations is excellent.”

A significant amount of credit for that belongs to the company’s Reserves Advisory Committee. The 23 members of this committee are nominated by their respective operating or technology companies for their expertise in operations, engineering, earth science and finance. To ensure that they meet the professional standards required by the SEC, the committee reviews the quantities and bases for classifying reserves as P1 and all significant changes in P1 reserves. They also review key fields on a three-year rotating basis. The committee then advises senior management on reserves with a goal of promoting consistency and quality in the company’s reserve and resource estimations.

While the rig that spudded the wells at Jack has moved on, the challenges continue. Now the work has moved onshore, where engineers, earth scientists and strategists are planning possible future development scenarios. The gears are spinning in the resource factory and decisions are underway that may one day bring Jack to life and turn its resources into reserves and true value.



Moving Experience

Our supply, trading and transportation businesses are united in their mission to get products reliably to markets.

When a major producer of refined products for the Latin American and Caribbean markets was unable to deliver last January, the region faced a shortage of roughly 10 percent of the fuels normally consumed. Disruptions are a fact of life in an area afflicted by hurricanes and earthquakes, and served by a widely dispersed infrastructure that depends on ocean-going vessels to carry products and relatively small facilities to store products. But this particular squeeze compelled Bereket Haregot - then Global Marketing's vice president for Latin America - to take stock of diverse customer needs across some 15 countries.

"We have more than 1,500 Texaco-branded service stations in Caribbean, Central American and Andean nations," says the Florida-based Haregot, now Global Downstream's vice president of Services and Strategy. "The commercial and industrial accounts that rely upon us exclusively - and the airports served by Global Aviation - are also priorities. But the most critical customers are the power plants that burn fuel oil to make electricity."



Chevron Shipping transports over 1 billion barrels of crude oil and refined products annually. To move natural gas to market, Global Gas has its own trading and marketing organization. Pictured at top of page is the gas trading floor in Houston.

Critical indeed. Many plants are government-owned. Some are an island nation's sole source of electricity. And if the lights go off across an entire country because the fuel runs out, guess who gets blamed?

"That would be Chevron," says Haregot, "which is why I've been so grateful for the people of Global Supply & Trading (GS&T), Chevron Shipping and at our Marketing terminals, who together frequently make problems vanish before they happen, which they did again last January."

In short order, 21 chartered ships with gasoline, diesel, jet fuel and fuel oil were acquired or reassigned in January alone - a 50 percent increase over the normal monthly

traffic for the past two years - and staged for timely arrivals at 18 terminals. One cargo of motor gasoline, for example, prevented a complete run-out in Honduras, while the acquisition of a ship-load of diesel and jet fuel prevented an aviation run-out in Guatemala.

Within Chevron, solving such disruptions is considered routine. To an outside observer, the actions might seem dramatic. "But to the end-customer the supplies appear to arrive seamlessly," explains Haregot. "It's reliability that differentiates Chevron from competitors in this region."

Movers and Traders

Reliability is a vital characteristic of Chevron's supply, trading and transportation (sometimes known as "midstream") business units that are strategically situated between Global Upstream's crude oil and natural gas fields, Manufacturing's refineries and the end customers of Global Marketing and Global Aviation. These key links in a formidable and diverse supply chain include the businesses of Chevron Pipe Line, Chevron Shipping and Chevron Natural Gas. Many of their interactions are coordinated with GS&T, with the goal of optimizing the collective value of each transaction to the corporation. Together the groups bring raw materials, natural gas, liquefied natural gas (LNG), company-refined fuels, and products purchased and traded on open markets to internal and external customers worldwide.

Indeed, last year Chevron produced 2.62 million barrels of oil-equivalent per day in more than 20 nations. Some of that crude oil was transported in the 28 vessels owned and operated by Chevron Shipping, which also has about 100 vessels under charter or control on any given day.

Established in 1895, Chevron Shipping manages roughly 3,000 deep-sea tanker voyages each year. It transports over 1 billion barrels of crude oil and refined products annually. In 2007, Chevron Shipping operated its own fleet without a single cargo spill. With offices in Houston, London, San Ramon and Singapore, Shipping works in close concert with GS&T to make certain that Chevron's refineries receive the optimum grades of crude - be it from company production or purchased on the open market - to manufacture the highest value products for their targeted markets. In turn, the floating armada of the supply chain then carries many of the Chevron-refined products to end users in areas as diverse as Europe, South Asia and the often challenging Caribbean and Latin America region.



Chevron Pipe Line's Control Center, where the pipeline systems and associated facilities throughout North America are monitored around the clock.

A Steel Web

The stationary piece of the chain is Chevron Pipe Line, which links together several other operating companies. With 12,181 net miles (19,603 km) of pipeline in North America – and more than 10 million barrels of storage capacity at crude oil product terminals and natural gas storage facilities – Pipe Line epitomizes the midstream.

"We can leverage the movement of products and add value for both the upstream and other downstream activities," says Pipe Line Commercial Advisor Scott McKay. "That includes moving crude from California's oil fields to Chevron's refineries in the state and bringing Chevron-produced midcontinent oil to the Salt Lake City Refinery. We're also one of the largest offshore pipeline operators in the Gulf of Mexico and have plans to execute a project to bring Chevron's Gulf of Mexico crude directly to one of our own refineries."

Increasingly, Pipe Line is contributing its knowledge to international projects. It provided support to Chevron's team that developed the CPC (Caspian Pipeline Consortium) pipeline that transports crude from the Tengiz Field in Kazakhstan to the Russian Black Sea port of Novorossiysk. The business unit has also contributed expertise to the development of the

West African Gas Pipeline, which in 2008 will begin transporting Nigerian natural gas to customers in Benin, Ghana and Togo. (Find out how pipelines are inspected and cleaned in this issue's "How it Works.")

Meanwhile, natural gas has its own trading and marketing organization in North America. Chevron Natural Gas (CNG) president, Randy Curry, explains: "We focus on three things: maximizing flow certainty and value for Upstream's natural gas production in the United States; providing reliable and competitive supply to our internal customers, such as refineries, cogeneration facilities and enhanced oil recovery operations; and building a portfolio of customers for future LNG imports."

Since its formation in 2003, CNG has become one of the leading marketers of natural gas in North America with sales of approximately 8.2 billion cubic feet per day.

Delivering Human Energy

A sign of Chevron's improving integration of the upstream and downstream value chain, and the key role of the midstream companies in the process, is the reopening of a 4 million-barrel tank farm at Las Minas, Panama. Originally part of a Texaco refinery closed soon after the 2001 merger, the facility has recently evolved into a strategic supply chain asset for the demanding Latin American and Caribbean region. Here, bulk cargoes are stored and broken into smaller shipments for use around the system, providing the flexibility that is a major part of Chevron's regional strength.

"We need flexibility because many countries in the region have different fuel specifications, port restrictions and small terminal infrastructure, which creates another set of commercial and operational challenges," says Danny Morales, a trader for GS&T Products Supply & Trading (PS&T) Latin American and Caribbean region.

Once PS&T secures the product purchases, it is then up to Chevron Shipping to find the vessels to carry the loads to market, a role handled by Charterer Anita di Meco. "I canvass the global market on a daily basis for ship availability," she explains, "including frequent collaboration with my counterparts in London and Singapore."

Efficient responses, like the one Chevron pulled off during the recent crisis in the Caribbean, do more than supply our many diverse customers. All regions have competition, and the seamless delivery of product helps to burnish Chevron's reputation for ingenuity and human energy.

"In the past year, a couple of governments were convinced to sign with another supplier who offered them remarkably generous financial terms," says Haregot. "Since then the supplier has had some reliability problems. Recently, another country was offered an attractive contract with the same supplier. But when the government considered what supply security meant to national security, they decided to stay with us."

That's the strength of a solid commercial connection. And at the end of the day for both the seller and buyer, it's the two-way payoff for a seamless supply of fuels.



HOW IT WORKS

Pigs: Sentinels of Energy's Underworld

The inside story of today's high-tech "line riders."

Have you thanked a pig today? Without them, the oil and gas industry's cardiovascular system of pipelines couldn't operate as efficiently or safely.



Pipelines can get corroded where they contact soil; clogged with sediment, wax or asphalt; filled with water "dropout" that can pinch capacity or cause internal corrosion; or dented by earth movements. To keep oil, fuel and

gas flowing smoothly, they need cleaning, unplugging and inspection.

They need "pigging," and the stakes are high.

Pipelines are safer and more cost efficient than tankers, trains or trucks. Obstructed lines can cripple production. Corroded lines may break -- in 2006, a line failure in Alaska's Prudhoe Bay Field fouled the Arctic environment and temporarily shut down 8 percent of U.S. oil production.

Most pigs are pushed through by the oil, fuel or natural gas carried in the line, moving at the speed of the flow. They come in dozens of varieties. Marshmallow-like "foam pigs" root out obstructions. Cleaning pigs bristle with steel brushes. Some flex like centipedes to turn corners.

But the true technological celebrities of the pigging world are the "smart pigs," which examine and record a line's condition as they go. Last year, Chevron Pipe Line (CPL) smart-pigged 78 lines, part of a pipeline integrity program in progress since 2002, says Mark Hildebrand of CPL's Asset Integrity and Reliability team in Houston. (For more on CPL's important role in bringing Chevron's products to market, see "Moving Experience" in this issue.)

How to Pig a Pipeline

First, a cleaning pig prepares the line, then a geometry pig tickles through with feeler-rollers, marking places that could trap a smart pig and force operators to expose and cut open the pipe, a disruptive and expensive exercise, especially offshore. Then come the smart pigs -- big ones for the largest-diameter lines can weigh a ton. Most employ "magnetic flux loss" technology, pinpointing corrosion inside or outside where the magnetic field "leaks" from the line walls.

Corrosion and metal loss are normal in pipelines over the years, but corroded lines are usually still strong enough to operate safely. Knowing exactly where and when they need fixing not only ensures safe operations, it saves a lot of guesswork and expense, says Hildebrand.

One experimental, Chevron-supported smart pig actually shrugs against the current of crude like a robotic caterpillar, testing the frontiers of pigging technology.

But pigging isn't just for Upstream. Chevron refineries employ smart "piglets" that zap the walls of narrow furnace tubes with ultrasonic sound at 1,260 readings per foot. Operators get a detailed map showing color-coded weak spots for repair – or just as valuable, confirmation of a safe and reliable facility.

As for the term "pig," some say it stands for "pipeline inspection gauge." Others claim the earliest straw and wire cleaners made a squealing noise as they scrubbed along. Smart pigs aren't a new technology – they made their first Chevron patrols some 40 years ago.

An external visual inspection was once the only method of inspecting a pipeline.* Then "hydrostatic" testing – filling a pipeline with pressurized water – became a common practice, and is still used today in "unpiggable" lines, mostly older lengths with too many obstacles to host a visit from a smart pig.

Growing fuel demand, heavy reliance on pipelines, tightening regulations and a strong emphasis on Operational Excellence should keep these sentinels of the oil underworld busy for years to come.

** Before the industry invented pigs, the best it could do to check for leaks was to send an inspector out on horseback to trot the length of exposed pipelines. These tough, intrepid "line riders" provided the inspiration for this magazine.*



Chevron Engineers Donate Skills To Improve Lives

Through Engineers Without Borders, poor communities are receiving help to build their own skills.

Capacity building is at the heart of our community engagement programs. Chevron engineers have discovered that helping people in developing countries sustain themselves also is central to the mission of a worldwide volunteer organization called Engineers Without Borders - USA (EWB-USA). And they're voluntarily giving their vacation time and talents to improve people's lives.

"When EWB-USA was just a fledgling organization, Chevron made timely financial contributions to support its growth, and an ever-growing number of Chevron engineers continue to contribute their time, talents and money through programs such as Chevron Humankind," explains John Shinn. He has served as a special advisor to the National Governing Board of EWB-USA since its inception and is also a team leader of Chevron's Global Issues Integration Advisors group at Chevron's Energy Technology Company (ETC).

Project Photo Gallery



A New Skill

Sieving sand for a slow sand filter pilot unit in Ngelenge, Tanzania.

Two ETC engineers John Wind, senior planning engineer, and Abby Hoats, environmental engineer, are highly involved in their local EWB-USA San Francisco chapter. Hoats, a Tanzania Project manager, is returning to that country this summer to help install a water distribution system.

Trevor Demayo, senior planning engineer for ETC Process Planning, is especially interested in the work EWB-USA does to raise awareness about appropriate technologies to meet development needs. He recently arranged for Bernard Amadei, the founder of EWB-USA, to speak about this for Chevron's Mentoring Excellence in Technology program.

In Houston, Marcos Flores, a facilities engineer for the MidContinent/Alaska business unit, and Chris Barth, a process engineer for ETC, are also active in EWB-USA. This summer Flores is leading an EWB-USA team that is building a water system in urban Bolivia.

"All of us — Abby, John, Trevor, Marcos, Chris and others at Chevron — are using our engineering training and our experiences on company operations around the world to make valuable contributions to EWB-USA. Using our abilities to build a global workforce and to improve the living conditions of people in the developing world gives great meaning and purpose to what we do," says Shinn. "Our commitment to EWB-USA makes us better at our jobs and in our lives."

As well as their shared approach to capacity building, Chevron and EWB-USA have many community engagement goals in common. For example, EWB-USA works closely with local nongovernmental organizations, and they form strong community partnerships in order to identify development needs. They also seek local resources for projects first and endeavor to make them economically and environmentally sustainable.

Ownership of the projects by the local communities is essential to the sustainability of them.

"Our work focuses on developing appropriate technologies for the communities we partner with," explains Wind. "We meet community needs by evaluating the resources available locally and by identifying community organizations that can sustain the project over the long haul."

Rural Tanzania Project

For example, in Ngelenge, a remote, rural, underdeveloped community of about 2,200 people in the southwestern corner of Tanzania, EWB-USA volunteers learned that an adequate, safe water supply was a high priority. The community also needed a health dispensary and better agriculture methods.

To address these needs, EWB-USA established a relationship with a local organization called the Ngelenge Development Association (NGEDEA).

In the summer of 2006, Hoats and other EWB-USA volunteers traveled to Ngelenge. They visited 147 homes there surveying women with young children about health conditions and water usage. They also conducted water quality tests. Their surveys and testing revealed that water stored in households was often contaminated with E. coli.



John Shinn, program leader for ETC's Global Issues Integration, addresses Chevron engineers on the merits of EWB.

Better water wells were another need identified in the community of Ngelenge. They had three shallow wells, only one of which provided potable drinking water. Because of long wait times at the wells, people there often did not have enough water to meet their daily needs.

Later in the summer of 2006, Wind worked with EWB-USA volunteers, NGEDEA members and community volunteers to install new deep wells in Ngelenge. The new wells increased the supply of clean drinking water for the community and laid the groundwork for a future water distribution system. A demonstration slow-sand filtration system also was designed and installed to make river water drinkable for people living too far from the wells to carry water to their homes.

Urban Bolivia Project

On another continent in the summer of 2006, Marcos Flores and Chris Barth worked on an assessment team for a new EWB-USA project funded by Rotary International located on the periphery of the city of Cochabamba, Bolivia. Once again tests conducted revealed contaminated water, and local surveys by EWB-USA volunteers identified the primary needs of the community as healthcare and water.

Last summer, Flores and Barth were part of a EWB-USA team dispatched to Cochabamba. The team determined that it was not feasible to install wells in the community, so they adjusted their project plans. This summer the EWB-USA team will return to Cochabamba again to work with a contractor and local Rotary Club volunteers to install a water distribution system with water supplied by cistern trucks.

“We’re very proud of the volunteer work our engineers are doing with EWB,” said Nadeem Anwar, Chevron’s manager of Community Engagement. “They are building partnerships and donating their professional skills to build capacity and motivate communities to take ownership of the water and health projects designed and installed collaboratively in their communities.”



We received some helpful feedback on our “e-cops” article in the last issue, as well as some appreciation for our explanation of sulfur and how it’s recovered.

Nailed it?

Thanks for the article on the great work our e-cops are doing to keep our company and workers safe (“On Patrol With the e-Cops,” April 2008 issue). I’m not much of an IT whiz, but it sure is reassuring to know that we have an organization and the personnel to fight back against cyber crime. And for us everyday computer users, Liz’s advice to “just use your computer for work, and use it safely and wisely” was on the nail. I’m going to pin that to my wall.

David Parums, Atyrau, Kazakhstan

This article had great content and good writing. However, I want to take exception to this part: “His machine displayed a salacious screen saver; a female in the audience complained; and IT Forensics was called in to investigate.” Did you have to identify the complainant as a female? I’m not speaking for the men who might find this offensive also, but I know there are good Chevron men who would also find this to be totally inappropriate and would complain. By adding the gratuitous [label] of gender, some readers may be thinking that this is only offensive to women, or worse, it is women that are the complainers in this company when it comes to inappropriate sexual material. Let’s have a company where foul language, inappropriate and harassing content is halted by all people, regardless of their gender/race/sexual orientation/religious beliefs, etc.

Annemarie Torrez, Bakersfield, California, United States

Element of Success

Just a comment to let you know that the write-up on H₂S and sulfur recovery (“Sulfur – An Essential Element,” April 2008 issue) is very informative, is well presented in a simple format, and the animation is excellent and to the point.

Phil Ilavia, Houston, Texas, United States