

Fuel-Gas Gains... an "Efficiency Resource"



Energy Management Workshop Participants at Kananaskis

An Energy Management Workshop, spearheaded by CETAC-WEST, and held at Kananaskis Jan. 15-17 drew more than 100 participants representing petroleum producers, gas-plant operators, technology providers, government, regulators and NGOs. The event also was sponsored by the Petroleum Technology Alliance Canada (PTAC), Environment Canada and the "Methane to Markets Partnership."

The gathering, the fifth of its kind in recent years, attracted participants from Canada, the United States and Mexico, who during the workshop heard how annually an estimated \$5 billion of fuel gas is used in field-gathering systems and processing plants in Alberta alone. They also heard how integrated energy audits, initiated by CETAC-WEST, of 18 such Alberta facilities found that with improved energy efficiencies, up to 15 per cent of that royalty-free fuel gas could be saved and sold. With some exceptions (notably straddle plants) the fuel gas is not even accounted for in producers' or processors' operating costs.

Even larger opportunities for fuel-gas savings exist beyond Alberta. If Canadian figures are extrapolated worldwide, fuel-gas consumption is

likely to be worth around \$75 billion/year but could very well be higher due to the different level of maturity of facilities and reserves in other countries. On the basis that 15 per cent of this could be saved through improved practices and better technology, we are looking at a realistic saving of about \$12 billion a year.

CETAC-WEST, through workshops and other means, has been in the forefront of encouraging more responsible fuel gas usage. As Alberta's gas fields age, fuel gas represents an increasing portion – now 10 per cent vs. eight per cent five years ago – of the volume and value of overall natural gas production.

"Who has stewardship of that resource?" asked Blaine Lee, in moderating a workshop panel of



John Rilett
Climate Change Central

government and NGO officials. Lee then suggested: "We're all stakeholders in this major challenge of fuel gas."

Panellists included John Rilett, Director of Energy Efficiency and Conservation with Climate Change Central (C3), an Alberta-based public-private partnership focused on global climate change. Rilett noted that due to increased activity, particularly in the oilsands, recent greenhouse gas (GHG) emissions forecasts by Alberta Environment, C3 and the Pembina Institute now place Alberta on a path toward faster CO₂ emission increases than those Alberta Environment predicted as recently as 2000.

But, Rilett said, improved efficiencies in the conventional upstream oil and gas sector, under one scenario, could lower projections by as much as 50 megatonnes a year by 2050 (see Fig. 1 this page).

"Upstream oil and gas efficiency is a significant piece in that projection. We're talking about hundreds of millions of dollars in potential

cost savings or enhanced revenue if we get this fuel gas into the pipeline and out to consumers," Rilett said. He added: "When industry puts its mind to it, it tends to do it very well."

Should government or business take the lead in delivering an aggressive

response to the annual estimated \$5 billion-worth of the fuel gas used during petroleum producing and processing in Alberta?

An industry conscious of the bottom line and of the need to

anticipate public concerns, rather than governments and regulators, seems the better bet, judging by panel discussions at the Energy Management Workshop. It was one of a series of such events organized by CETAC-WEST in recent years aimed at improving fuel-gas efficiency. The events also have become venues for introducing new technologies and practices leading to more responsible fuel-gas use.

During a panel discussion, Michael Burke, Director of the Industrial Programs Division of Natural Resources Canada, stressed the business case for energy conservation but also listed several hurdles to better energy management. They include a lack of access to capital and perceived low returns from energy-efficiency improvements.

Helen Ryan, Director Oil, Gas & Energy with Environment Canada underlined the federal government's commitment to tackling environmental issues in an "integrated" and "comprehensive" fashion. She indicated that the upstream oil and gas sector is a key sector that will be targeted as



Helen Ryan
Environment Canada

part of the government's Clean Air Agenda. The fuel gas consumption from this sector accounts for roughly 99% of NO_x and 73% of CO₂. Fuel gas efficiencies and optimization opportunities exist and present a win-win opportunity for industry to save dollars and to reduce direct air emissions, "I encourage industry to take action to reduce emissions."

Michael Bruni, Executive Manager of the Energy Team at the Alberta Energy and Utilities Board (EUB), listed environmental protection, conservation, public safety and service as cornerstones of his agency's mandate. But he added: "Regulation is not always the way to ensure that those cornerstones are met."

Acknowledging the need for improved fuel-gas accountability, Bruni cautioned against seeing

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The Fuel-Gas Challenge: Who is Counting... Who is Minding the Store?

By Joe Lukacs
President CETAC-WEST

We have a challenge on our hands – the \$5 billion challenge in Alberta and perhaps \$100 billion worldwide – of more responsibly using the fuel gas that allows us to produce petroleum from the ground and that turns our oil and gas into saleable commodities. The question we must ask ourselves is: "How much fuel gas should it take to produce 1 Mcf of sales gas?"

For the last five years, CETAC-WEST has journeyed with those plant operations personnel who participated in the Eco-Efficiency Program and the five Energy Management Workshops that we organized. Early on, we may not have been exactly sure just where our journey was taking us. But with time, our destination has become clearer, namely promoting responsible stewardship and more accountable use of fuel gas.



CETAC-WEST President Joe Lukacs

There appears to be a fairly strong consensus that we have a problem with fuel-gas ownership and wastage. What's less clear is just who is up to the challenge of championing the cause. We're ready to dance but unclear as to who should lead. Should leadership come from industry, from government or the public?

The fuel-gas challenge is reminiscent of what sometimes is referred to as the "tragedy of the commons" – a situation where a shared or "free" pasture that gives everyone access, while imposing responsibility on no one, results in overgrazing.

How much fuel gas should it take to produce 1 Mcf of sales gas?

While the value of the fuel gas consumed each year in Alberta is estimated at around \$5 billion, that's not what producers or processors spend on it. In fact, nobody really pays for it. Not only is much of it not accounted for, but audits show part of that fuel gas is not used efficiently.

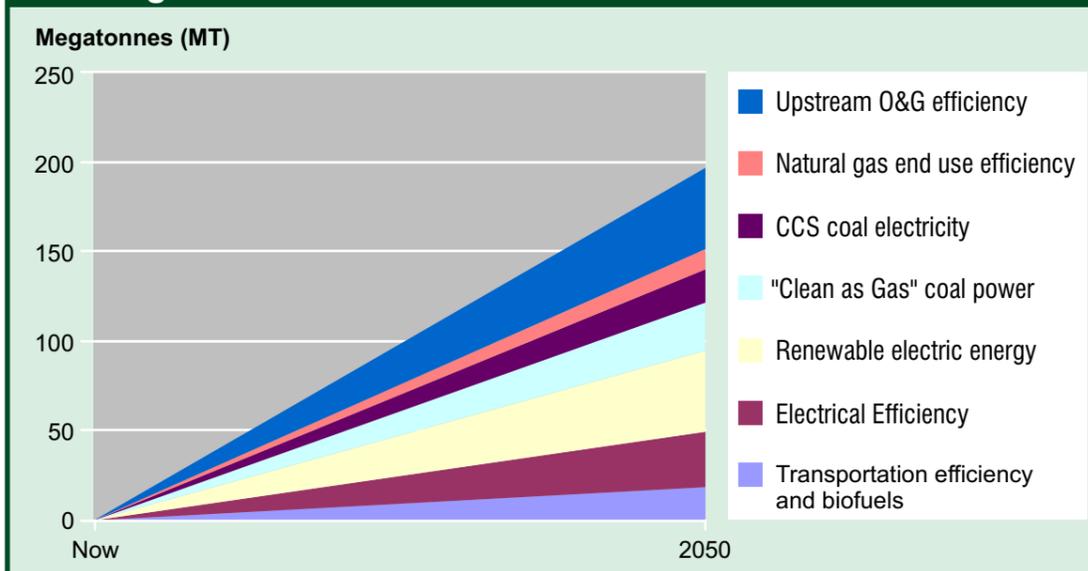
A series of CETAC-WEST - sponsored integrated audits of selected gas plants and related facilities have documented the waste. A leaky valve here, over-circulating amine system there – add it all up and we may find we're using up to \$1-billion-worth of gas a year needlessly because of poorly operated equipment and processes and because no single individual is accountable for it!

Responsible fuel-gas management is as much a fiscal responsibility for industry and government as it is a professional responsibility to ourselves.

Failure to respond appropriately to the fuel-gas challenge will not only add to environmental damage, it will also impact corporate bottom lines.

As Albertans and Canadians, we have an unrivalled opportunity to become world leaders in the area of fuel-gas conservation. Who will lead us?

Fig. 1: Alberta Non-Oil Sands GHG Reduction Potential



Projected reductions in GHG from non-oil sands industries (Source Climate Change Central)

Fuel-Gas Gains... an "Efficiency Resource" (continued)

regulation as "the catalyst for that to happen." Rather, the EUB will stress shared accountability and responsibility, and collaboration with industry.

Alberta Energy's Manager of Gas Operations Policy, Karen Henderson, outlined initiatives leading to the formation last May of a government-industry committee examining fuel-gas issues.

"We want to share our findings with industry and other governments," Henderson said, "and we will look at policy and regulation changes, as they are deemed necessary."

Javier Bocanegra of Mexico's state oil company, Pemex, who

co-chairs the oil and gas subcommittee of the international "Methane to Markets Partnership", was also a panellist. The 19-nation group, which includes Canada, focuses on cost-effective reductions of methane emissions from four key sectors, including oil and gas.

Bocanegra said his company considers the "Methane to Markets Partnership" a "very good platform to help us reach our goals as a responsible company in terms of economics and energy conservation."

There are hopeful signs that some international companies and their senior executives are heading the fuel-gas challenge and taking that message to heart.



Workshop panel with governmental and NGO representatives.

Roger Fernandez, team leader with the U.S. Environmental Protection Agency (EPA), outlined details of a program supported by top-echelon management at Devon Energy. These efforts, initiated under the EPA's Natural Gas "STAR Program", track and account for gas saved and captured by the company.

It led to capture and reduction in 2004 of almost 8.2 million tonnes of methane (worth \$34 million U.S.) that otherwise would be lost within Devon's U.S. operations.

By plotting and recognizing success, Fernandez said, "the program has gained momentum and divisions within the company are now competing with each other on fugitive emissions reductions."



Roger Fernandez EPA

Proportion of Fuel Gas Used Continues to Increase

Ten per cent of the natural gas produced in Alberta is used to extract, clean and eventually ship gas to market. And, says Al Wakelin, of Energy Experts of Calgary, when gas used for production of conventional and heavy oil also is added in, that fuel gas has an annual value of some \$5 billion (at \$8 a gigajoule).

the fuel-gas use. In short, it's time for those who can make a difference, to do so."

While Alberta's total gas sales have increased slightly in recent years, the percentage of that gas used as fuel gas is creeping steadily upward to 10 per cent today, compared to eight per cent five years ago. This reflects

that at six cents a gigajoule "it was dirt cheap." The then-limited pipeline capacity to ship any gas that might have been conserved during processing created a mindset that fuel gas was "not worth chasing."

number of changing factors, notably: maturing gas production (expected to decline); significantly higher natural gas prices; and increased public awareness of the need to reduce waste and GHG emissions.

We now operate in a totally different business and public policy environment with a

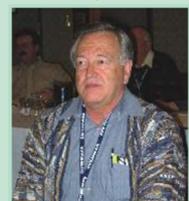
Better procedures and technologies – many already available – could capture much of the wasted or underutilized fuel gas identified in the CETAC-WEST



Al Wakelin Energy Experts

audits. Wakelin also stressed that "fuel gas is viewed as free and does not show up as an operating cost. Therefore, it's used and slides off the radar screen."

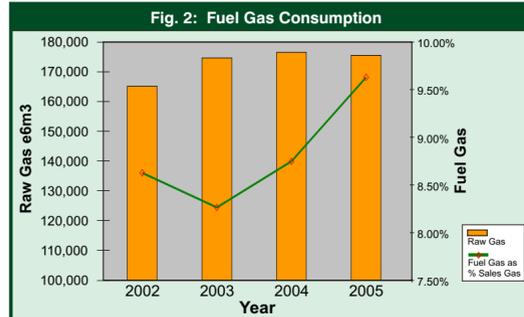
He added: "What is needed to change this is for corporations or management at the highest corporate levels to grab hold of and take some responsibility for



John Squarek CAPP

maturing Alberta gas fields that require added compression to deal with declining pressures. The changing composition (including sulphur species) of the gas plus the fact that plants are operating at below capacity also cause inefficiencies and the use of relatively more fuel gas.

It is not surprising that fuel gas historically was not considered a cost of production. As the Alberta gas industry expanded 40 years ago, production was high and the new fields and infrastructure meant a smaller fraction of gas was used. John Squarek noted



"Fuel gas is viewed as free and does not show up as an operating cost. Therefore, it's used and slides off the radar screen. What is needed to change this is for corporations or management at the highest corporate levels to grab hold of and take some responsibility for the fuel-gas use. In short, it's time for those who can make a difference, to do so."

Al Wakelin, Energy Experts

Fuel-Gas Reporting Lacks Consistency

A consultant outlined a very mixed commitment on the part of upstream producers and mid-stream processors in measuring and reporting on fuel-gas use in their facilities.

Don Gabruck, of Energy Experts, reported to the 2007 Energy Management Workshop on a survey in which information was sought from 62 facilities. In 32 cases, the operations provided full disclosure, while another five provided partial data.

Gabruck discussed several specific examples, for instance a sour gas operation that measured all fuel gas used in the plant but only measured fuel-gas use at less than a third of its batteries. In contrast, a sweet-gas plant reported measuring all of the gas use in the plant and also its field usage. However, neither operation included gas used in processing as a budget item.

A third case study, involving a straddle plant, not only measured all fuel gas used but



Don Gabruck - Energy Experts

submitted this data to the operating superintendent. The amount and cost of the gas consumed became an integral part of the operating budget. According to Gabruck: "Straddle plants provide a model that could be emulated."

Gabruck indicated that Alberta Energy and Utilities Board directives for measuring and estimating fuel-gas use are not well understood, and there is little evidence that management is involved in any stage of the process. Furthermore, noted Gabruck, there are few checks and balances to detect or correct the quality of fuel-gas measurements and estimates.

New Technologies Bring Solutions for Energy Market

The 2007 Energy Efficiency Workshop provided opportunities during technology presentations for proponents to show new energy-related products and processes. Petroleum Technology Alliance Canada (PTAC), Methane to Markets, Environment Canada and CETAC-WEST sponsored the session.



Improving Efficiency of Firetube Heaters

Firetube heaters are used extensively throughout the upstream oil and gas (UOG) sector to provide heat for freeze protection, dehydration and to sweeten gas. There are more than 40,000 such heaters in Alberta and a recent study, headed by Petro-Canada Energy Efficiency Engineer Phil Croteau, showed that many immersion heaters have low fuel efficiencies (between 30 and 60 per cent) compared to the 70 to 80 per cent achieved by power boilers.

At an average cost of \$5/GJ, this represents \$100 million to \$150 million a year of lost revenue due to inefficient operation and also an associated 1.5 million additional tonnes of carbon dioxide discharged to the atmosphere.



Infrared Cameras Find the Leaks

Finding leaks from flanges and equipment is not always easy and can be expensive. An infrared (IR) camera, with hydrocarbon and VOC filters, provides a visible image of hydrocarbon-gas emissions in real time. The IR camera used by ConocoPhillips provides rapid, accurate and safe leak detection.



While other technologies are available, they usually require an operator to take measurements right at the source. This can be difficult when flanges are at elevated locations and may expose the operator to hazards if the leak is toxic or in very congested areas.

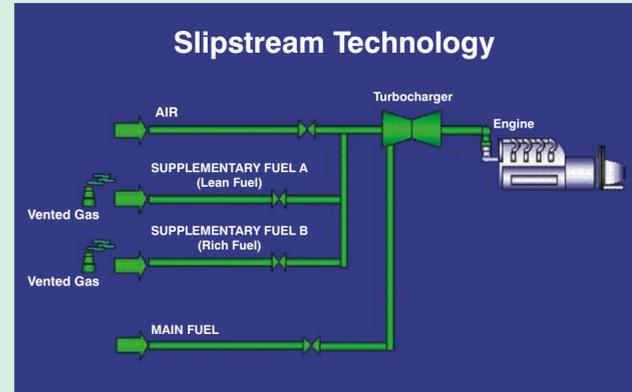
The IR camera can scan these hard-to-reach locations from a distance and make assessments without interrupting operations. The ability to locate leak points exactly reduces repair time and cost compared to conventional leak-detection methods. The visible indication of a leak allows hundreds of components to be scanned simultaneously.

Currently, IR cameras cost about US\$75,000 so they represent a significant investment but they soon pay off through ease of use and time saved in conducting a comprehensive survey.

REMVue Slipstream Puts Fugitive Emissions to Work

Natural gas engines are used extensively in the UOG, mainly to drive compressors. The REMVue Slipstream™ technology allows fugitive emissions to be introduced into the compressor air intake to reduce fuel-gas requirement. REM Technologies is demonstrating this technology, where as much as 50 per cent of the engines' fuel requirements will be supplied from fugitive emission sources. The technology must be used with the well-proven REMVue control system and provides the same level of speed control regardless of the volume and composition of the fugitive emissions available.

The fugitive emissions can vary widely in composition and may include BTEX compounds. These emissions, normally vented to the atmosphere, are essentially free. Given that a typical 1200 HP engine yearly burns about

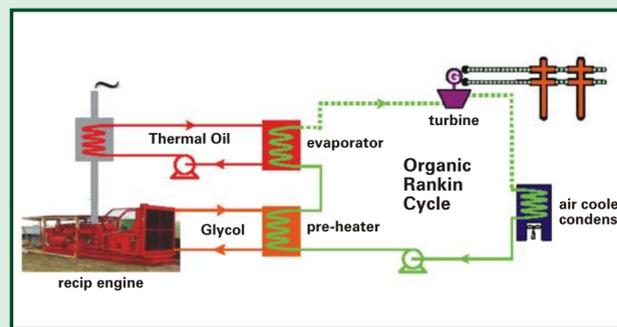


\$500,000-worth of fuel, the savings can be considerable. Equipped with REMVue's Slipstream technology, the savings can be up to 50 per cent or \$250,000 per year.

One Slipstream application using fugitive emissions of methane for 20 per cent of the fuel reduces the GHG emissions equivalent to that produced by 3,600 vehicles.

Energy Recovery from Reject Heat

Great Northern Power (GNP) is a power developer and a promoter of Organic Rankine Cycle (ORC) technology for small-scale (less than 5 MW) power projects. These projects are fuelled by recovering waste heat from the cooling jackets and exhaust stacks of internal combustion engines. GNP's technology can extract heat from any source over 95°C and use it to drive an electrical turbine or pumps and turbines. This makes combustion engines an ideal source of free energy.



significantly reduced cooling requirements for the combustion.

Given that combustion engines typically reject more than 60 per cent of the fuel energy as heat, the opportunities are large. Capturing a portion of the cooling-jacket reject heat can improve the engine efficiency by more than five per cent or by 12 per cent by adding exhaust-heat capture. A side benefit is

Finding Profit in Fixing Leaks

Companies involved with the Methane to Markets partnership find that valves, connectors, compressor seals and open-ended lines are major sources of leaks in the UOG.

Gas leaks are invisible, unregulated and go unnoticed, notes Don Robinson of ICF Consulting.

It is estimated that, in the U.S., compressors alone result in about 3 billion cubic feet of fuel-gas emissions each year. A similar amount is emitted from open-ended lines.

There are more than 5,000 natural gas engines employed in the UOG and the annual fuel bill is around \$900 million. Furthermore, they produce over one per cent of Canada's GHG emissions.

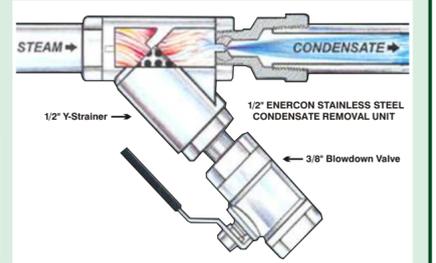
The largest individual sources of leaks at gas-processing plants are pressure-relief valves and compressor seals. Clearstone Engineering reports that the average leak from a single relief valve amounts to over 800,000 cubic feet per year and that from a single compressor seal can be almost 400,000 cubic feet per year.

Fixed Orifice Steam Traps Improve Efficiency & Cut Maintenance

Replacing mechanical steam traps with a fixed orifice trap can save 10-30 per cent of steam cost, according to Patti Lowe of MEI Resources. Unlike conventional traps that open and close, fixed orifice steam traps provide a continuous flow of condensate. According to Lowe, the fixed orifice traps do not need to be replaced – resulting in a big maintenance saving. More importantly, they improve heat transfer and resolve condensate problems.

Because of the significant density difference in steam and condensate, fixed orifice traps can be sized for each application but typically a plant would only use two or three different sizes. Lowe said tracers can be spaced at 250 ft., compared to about 150 ft. with mechanical traps.

The reliability of fixed orifice traps is important in places like Fort McMurray where dealing with frozen lines is costly.



BP Cuts Fuel-Gas Use At Alberta Well Site

BP Canada has embarked upon a program to dramatically decrease fuel-gas consumption and methane emissions from one of its Alberta well sites. BP Canada's Milos Krnjaja outlined technologies employed.

The current site comprises two wells, two three-phase separators, two chemical pumps, two catadyne heaters and associated instrumentation and controls.

The current estimated fuel consumption (excluding heaters) is 5.5 MMscf a year for an annual cost of \$27,500 (at \$5.00/Mscf).

Through a combination of solar, wind and pressure energy, BP will be able to power devices directly, along with a small air compressor to indirectly power devices with instrument air. Though these technologies are not new, harnessing them all to produce electricity and to power instruments and pumps on a continuous basis is new.

To have power available at all times, a battery bank must be incorporated. BP intends to demonstrate that this is possible year-round even in northern locations.

At a cost of around \$25,000, this installation will offer a four-year payback if GHG credits are excluded and two years when the credits are included.

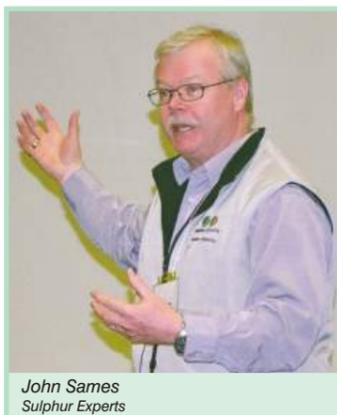
Towards Sustainability

Integrated Audits Show the Way: Benchmarking Keeps the Score

Integrated Audits

Integrated audits are the keystone of the Eco-Efficiency Program developed through CETAC-WEST, according to John Sames of Sulphur Experts. This is the starting point for finding where the problems are and for coming up with practical solutions. Typically, a team of six to eight experts gather background data on the plant and in discussions with key operating staff flag potential problem areas. They then comb the plant for three to four days taking measurements and applying their process specific knowledge in

areas such as compression, refrigeration, steam generation, dehydration and sulphur recovery. Process diagnostics is not unlike a visit to the doctor, said Sames. You need to be able to determine what and why things are happening before you can prescribe the remedy.



John Sames
Sulphur Experts

operations and to create a practical set of tools that could be used by operating personnel to identify and prioritize areas of operational improvements.

Wakelin noted that only publicly available data was used by CETAC-WEST, a fact that excluded electrical consumption from the analysis.

It quickly became evident that the

diversity of the UOG did not lend itself to a broadly based assessment of performance and therefore it was necessary to adapt traditional benchmarking techniques to fit this industry.

When similar facilities are assessed, the output is more meaningful. This led CETAC-WEST to identify four primary clusters comprising sour gas, sweet gas, conventional oil and heavy oil.

The initial thrust was to track the fuel-gas intensity within these clusters. This served to show how energy consumption varied over time and allowed an individual plant to compare itself with similar facilities in the same cluster.

Feedback from industry had a significant impact on the programs' development.

"The greatest priority is for easy-to-use tools to improve the efficiencies at the unit operations level in the facility," said Roy

Kanten of Shell Canada Ltd. Energy intensity indicators at the level of the facility are useful for tracking the performance of that facility. Energy intensity comparisons between facilities should be



Roy Kanten
Shell Canada

Fig. 3: Fuel-Gas and Energy Intensity in UOG Sectors

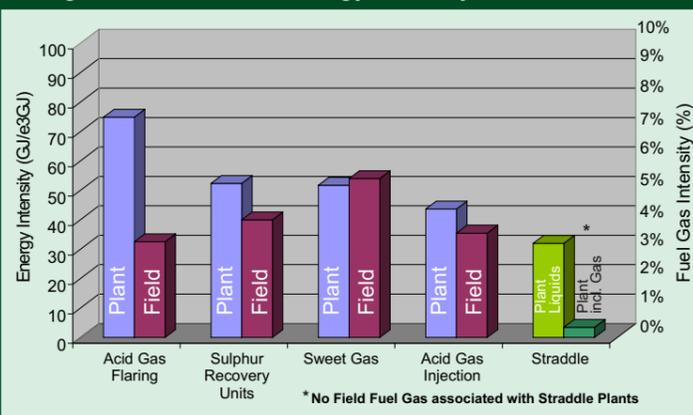
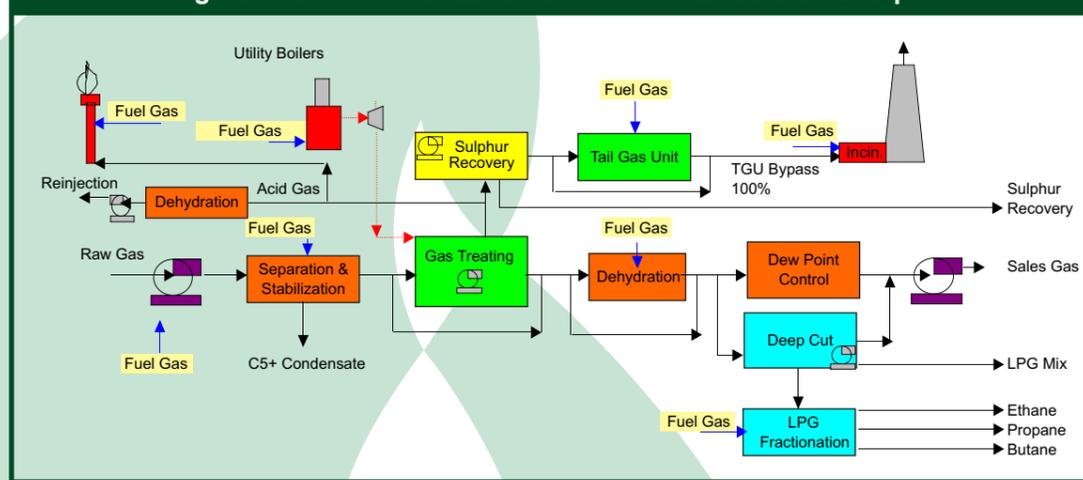


Fig. 4: Generic Gas Plant Model - Overview of Fuel Gas Inputs



Benchmarking

Benchmarking is a powerful tool that can be used to gauge performance and to monitor the impact of changes but to date there has been limited application of this in the upstream oil and gas (UOG) sector. According to Al Wakelin, the primary objectives of the benchmarking program were to provide industry with a means to monitor the efficiency of their

made very carefully and must take into account variations in acid gas content, liquids, and the age of the field and the facility.

In response to this, unit optimization models were developed for DEA and MDEA sweetening systems, glycol dehydrators, compressors, tail gas incinerators and acid gas injection.

In addition, work on a comprehensive model has commenced to

address the specific features of individual plants and their feed. When completed, this model should provide a valid indicator of what the energy consumption for

that plant, and in fact each of the unit operations, could be if systems and equipment were fully optimized.

Companies Take Up Fuel Gas Challenge

Several representatives of Canadian producing companies and gas-plant operations outlined progress being made on the fuel-gas front. Blake Reid, of Husky



Blake Reid, Husky Energy

Energy Inc., explained how his company's Ram River gas-processing plant near Rocky Mountain House has benefited by participating in fuel-gas integrated audits sponsored through CETAC-WEST.

According to Reid, the audit findings "resulted in a change of

culture. In the past, things may have gone unnoticed. The data helped justify funding. The audit report raised some eyebrows and got things moving."

Specifically, it led to investment and optimization of Ram River's sulphur recovery, wastewater and amine operations

Cyril Garvey, of Northrock Resources Ltd., an upstream oil and gas exploration firm, has also put to work lessons from the CETAC-WEST-supported audits.

"The audits led to several new steps to reduce fuel-gas emissions," said Garvey, adding "it has paid the cost of the auditors several times over."

Northrock now uses solar panels to power a sizeable number of its production batteries and, Garvey told the workshop, the audits led to a change of thinking from "the frontline operators to the senior executives."



Cyril Garvey,
Northrock Resources

Workshop Comments

"It is easy to point a finger at others, but maybe you should point the finger at yourself. You have to do what you can to make things happen."

Don Robinson,
ICF Consulting

"Industry is aware of the value of fuel gas but expenditures are made on the relative value of competing opportunities."

Rudy Sundermann,
EnCana

Audits Need Follow-up To Prevent Backsliding

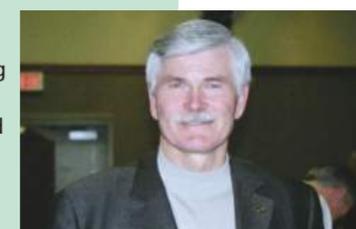
When it comes to energy reductions, good intentions are not always enough – persistence and follow-through are also needed.

Brian Tyers of Stantec Consulting noted that an energy audit of a Central Alberta gas plant pointed to production-energy savings averaging around 15 per cent and ranging from \$400,000 (nine per cent) to \$900,000 (20 per cent) annual savings.

However, Tyers noted, when auditors checked back nine months later, it was apparent that many recommendations were not being followed, partly because the plant had no system to monitor and target the energy use. That is not unusual, and Tyers noted a Stantec survey indicated that less than 25 per cent track their energy use.

An outcome was Cumulative Summation (CUSUM), a tracking tool developed by Stantec. CUSUM establishes a baseline of a plant's energy (including fuel

gas and electricity) consumption, and then predicts energy use and compares it to actual use.



Brian Tyers, Stantec

"The lack of monitoring and targeting can erase any energy management gains. With CUSUM you can hold and extend those gains," Tyers said.

Besides a monitoring tool, it is also important that every facility maintain ongoing reporting of energy use and designate someone to champion effective energy use.

That way, Tyers suggested, "You can retain energy conservation and have a positive energy management program."

To find out more about CETAC WEST, please contact us at:



CETAC-WEST

CETAC-WEST is a private-sector, not-for-profit corporation established in 1994 by Environment Canada and supported by the Alberta and Federal Governments.

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