PETROLEUM TECHNOLOGY ALLIANCE CANADA

Facilitating innovation, collaborative research and technology development, demonstration and deployment for a responsible Western Canadian upstream hydrocarbon energy industry.

Business Case for Energy Efficiency in the Upstream Oil and Gas Industry

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Acknowledgements and Disclaimer

About the Industrial Energy Audit Incentive (IEA) and PTAC

Industrial Energy Audit Incentive - The Government of Canada has been working with industry for more than 25 years to promote energy efficient industrial practices. Building on the success of this partnership, Natural Resources Canada (NRCan) has a financial incentive to help industrial companies identify ways to increase energy efficiency, improve production processes and cut costs. This incentive is designed to help defray the cost of hiring a professional energy auditor to conduct an on-site audit at an industrial facility. Funding is available for up to 50 percent of the cost of an energy audit to a maximum of $5,000. This is an exclusive service for companies that are registered with NRCan's Industrial Energy Innovators Initiative (IEII). By using energy more efficiently in the extraction, refining and delivery of natural resources and in the manufacture of products, industry can become more competitive and help reduce greenhouse gases.

Petroleum Technology Alliance Canada - PTAC is a not-for-profit association that facilitates collaborative research and technology development to improve the financial, environmental and safety performance of the Canadian upstream conventional oil and gas industry. The purpose of PTAC is to provide a mechanism that facilitates collaboration on R&D to the benefit of those involved. PTAC acts as a matchmaker between those that have problems or opportunities and those that have potential R&D solutions. PTAC brings stakeholders together to identify areas where R&D will make a difference, and to launch specific projects to address these problems or opportunities. PTAC promotes industry participation in the resulting R&D and assists with securing funding from a variety of sources. PTAC also facilitates the transfer of commercial technologies from other industrial sectors for application in the upstream oil and gas industry.

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Disclaimers

This document is **intended as an summary of views on the business case for energy efficiency, as developed by the author, after consultation with PTAC and industry representatives**. Any suggestions and/or recommendations discussed or referred to are the authors, and have not been extensively reviewed or endorsed by PTAC staff, board members or other members. Use should be limited to encouraging further investigation and understanding of the issues,

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1. Executive Summary

A potential energy efficiency prize of over $1.5 billion/yr has been identified in the Upstream Oil and Gas Industry, out of a total energy use valued at over $12 billion/yr. The Business Case for Energy Efficiency in the Upstream Oil and Gas Industry illustrates that there are a large number of factors that can hinder progress on increasing energy conservation, despite the large potential prize. These factors are not necessarily technical barriers, but instead are motivational barriers which impact producer priorities and ability to invest in energy efficiency. The objectives and interests of all industry stakeholders must be reasonably addressed to allow optimum and appropriate efforts to conserve energy.

- **Producing Provinces** – As the primary resource owners are expected to protect the short and long-term well being of residents, by balancing economic, environmental and societal priorities, and implementing regulations, or incentives, to create a level playing field where the desired results can be achieved.
- **Canadian Government** – Has primary responsibility for national and international policies and agreements, such as Kyoto, but must recognize that GHG reductions are not the primary environmental drivers in producing provinces that they may be in consuming provinces. They must understand that issues such as water supply, Criteria Air Contaminant (CAC), emissions, land use, protection of ecosystems, shortages of labour, energy costs, and other factors have greater impacts and higher priority than producer energy efficiency.
- **Producers** – are driven by their fiduciary responsibility to maximize returns on shareholder capital which tends to force them to invest in high return, new development rather than still economic, but lower return energy efficiency measures.
- **Technology Providers** – Must be aware of the economic motivators of the producers, so they can properly assess business opportunities and market realities related to demand for energy efficient devices and processes.

- **Research Providers** – Must recognize the importance of low capital cost when proposing new energy conservation technologies. They must set realistic economic targets for solutions that take into account the costs of already existing solutions, which for various reasons may already solve a given problem but are not widely used by the industry.
- **Investors** – Investors in oil and gas producers or oil and gas service and supply providers, must understand more than the rates of growth or financial performance indicators. In many cases they require more information than is normally contained in oil and gas producer annual reports to make informed investment choices.
- **Public** – The public, living in the producing provinces, is having an ever-growing impact on oil and gas producers operations. In any case, where regulations don't appear to meet the public need, much more expensive and disruptive litigation is being used as an alternative to control oil and gas development. Public priorities in producing provinces are more focused on reductions in CAC emissions, impacts on life-style, land-use, health concerns, and jobs. When the public sets a low priority on energy efficiency in their own activities, it also tends to be a lower priority in their concerns about oil and gas operations.

Motivating increased energy efficiency in upstream oil and gas operations will therefore be more driven by:

- **Provincial Regulation** - controlling efficiency in operations to motivate the producers to make the relatively modest investments (<2-5% of annual expenditures) required for increased economic energy efficiency modifications.
- **Increased Measurement and Monitoring –** to provide facility operators with enough information to properly monitor energy use in their operations, so they can make the non-capital intensive adjustments or perform maintenance to minimize waste.
- **Clear Government Policy –** Uncertain government policy hinders implementation of mitigation measures, as producers want to avoid investment in measures, which may not later be recognized or rewarded.

➢ 2. Background - Current Situation Assessment

The upstream oil and gas industry consumes over 1,300 PJ/yr of energy in its operations. As indicated in Figure 1, over half of the energy is used in natural gas production, processing and transmission, with most remaining split between production of oilsands, light/medium and heavy oil. With this large energy use occurring at over 20,000 sites and with a wide range of facilities and situations, the potential for gains in energy efficiency are high. In fact energy audits and studies consistently show potential for energy efficiency gains in fuel use, of 15% or more and even greater savings in specific streams such as vents and flares.

In 2003, PTAC prepared an initial business case for energy efficiency, which outlined these potential savings, in order to promote greater efforts on energy audits and mitigation activities in the upstream oil and gas industry. Two years later, it was realized that articulating the prize was not enough to motivate conservation.

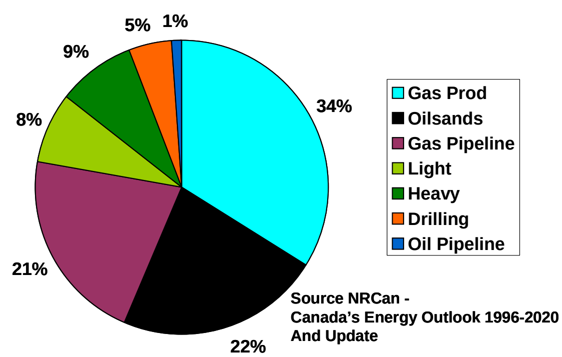


Figure 1 – Upstream Oil and Gas Energy Use – Projected 2005

In 2005, in on-going support to the Office of Energy Efficiency's Industrial Energy Audit Incentive, PTAC was asked to revisit the Business Case and to reassess what would be needed to encourage primary hydrocarbon producers to invest time and effort in energy efficiency. To gather input, a working group session was held on June 8, 2005, with representatives from NRCan/PTAC, producers, consultants and research organizations to discuss the business case and industry motivation for energy efficiency. (see notes in Appendix A). A key feedback was that energy efficiency was hard for producers to justify for a number of reasons:

- **Capital Intensive** – Conserving energy by retrofitting thousands of existing operations, is more capital intensive than investing in a new gas well to recognize the same increase in sales volumes and revenues. Most producers are looking for simple economic payouts on capital in less than six months or one year. As a result energy efficiency opportunities must be very attractive to encourage investment and must not threaten production, as one day of lost production may negate many years of small savings.
- **Manpower Intensive** – As well as being capital intensive, modifying existing facilities is also manpower intensive and requires highly qualified, skilled and experienced engineers, technologists and operators to complete changes in a safe and efficient manner. Since 1990 there have been “booms” in gas development (gas production doubled between 1990 and 2000). Currently heavy oil and oilsands are demanding more efforts while, at the same time, companies are under-pressure from investors to reduce overheads, resulting in staff “downsizing” and early retirement of knowledgeable “baby-boomers”.
- **Poor Understanding of Volumes** – In many operations there are few or no meters recording fuel use. In metered large facilities it is still difficult to isolate the fuel use of individual unit energy consumers. This makes it difficult to justify facility modifications as potential savings cannot be assessed easily and the results of improvements cannot be quantified. Often, once volumes are measured, it is recognized that losses are much higher than expected.
- **Inertia of Past Practices** – Many of the designs of plants and facilities currently in operation were commissioned between the 1950 and 1980’s when natural gas, the primary fuel in use, was worth well below $1/GJ, with limited seasonal markets. At the same time losses to flaring and venting were considered normal and not identified as an environmental concern unless they contained significant levels of hydrogen sulphide.

- **Negligible/Hidden/Long-term Fuel Costs** - Most of the fuel used by the Industry is "Off-the-Books" and is generally not accounted for in annual producer operating costs, revenues or asset values, since produced gas used for fuel attracts no royalties, direct costs or financial transactions. Fuel use is included in gas reserves calculations as "shrinkage" or "surface losses", but not accurately measured or adjusted as fuel demands change. (Fuel use indicated for a gas pool may be between 5-40%, deducted from the reserves, and is a relatively static number that is often only reported in increments of 5%).
- **Lack of Corporate Champions/Leadership** – Finally, it was recognized that corporate leaders are generally rewarded by shareholders for growing their company's assets and share value, but not for operating efficiently. Even the "greenest" producers have a fiduciary responsibility to shareholders to maximize returns on investment, so their focus is on mergers, acquisitions, and exploration, and not on optimizing existing operations.

As a result of the above issues, new solutions are needed to motivate energy efficiency.

2.1 The Prize is there

In PTAC's 2003 business case, it was assumed that most of the energy used and therefore saved by energy efficiency, would be natural gas at $5/GJ for a total energy bill of $7 billion/yr. In 2005 this estimate was reworked to reflect the cost impacts of purchased fuels vs. "off-the-books" fuel consumption. This new assessment indicates an industry energy cost of over $12 billion dollars through consumption of natural gas (produced and purchased), produced oil, purchased liquid fuels and purchased electrical power.

As "on-the-books" energy streams (power, liquid fuel and purchased gas) are a key focus of traditional operating cost reductions, these tend to be the primary target of producer's initial energy efficiency activities. Much of the effort, and largest economic opportunities, are to replace "on-the-books" energy sources with "off-the-books" energy. E.g. using upgraded bitumen to displace purchased natural gas in the oilsands and using vent or flare gas to back out purchased fuel in heavy oil operations.

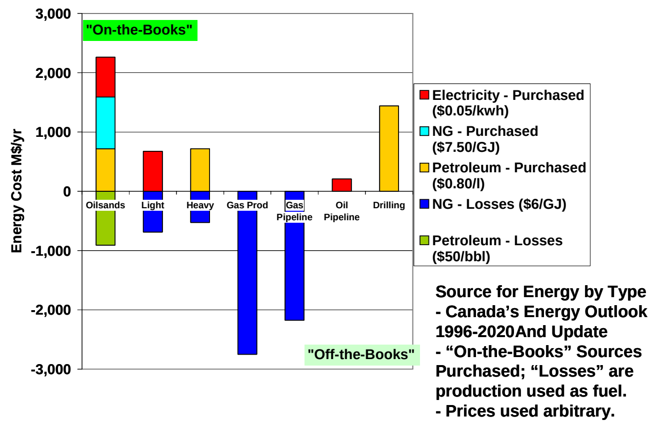


Figure 2 – Estimated Value of 2005 Energy Use by the Canadian Upstream Oil and Gas Industry = Over $12 B/yr

The alternative, to displacing expensive fuels with lower cost fuels, is to work to reduce total energy use by improving efficiency in some key energy consumption areas for each sector. This potential savings is estimated at over $1 billion/yr and would require a total assumed investment of $2.2 billion dollars vs. the annual industry capital expenditures of $26.8 billion/yr.

2.2 Compression – For natural gas production and transmission most of the energy use is "off-the-books" natural gas consumption for compressing the produced gas. Assuming a 15% fuel savings in production compression and a 10% saving in transmission compression, the potential annual saving of natural gas at $6/GJ would be over $400M/yr.

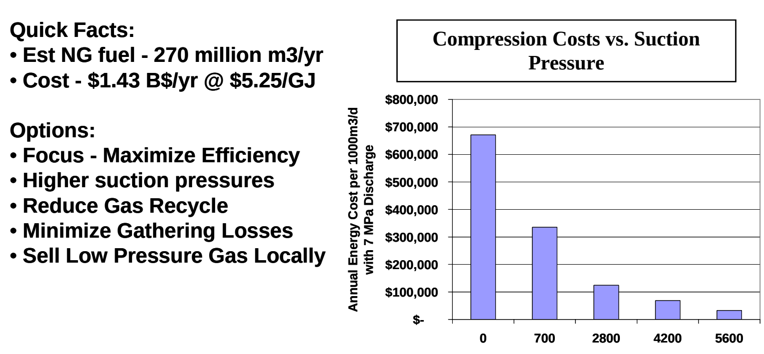


Figure 3 – Impact of Compressor Suction Pressure on the Energy Costs

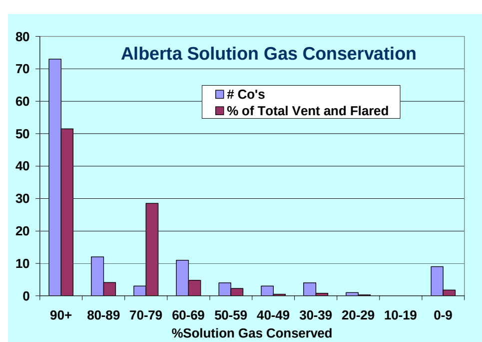
Saving will come from improving control of fuel use in compressor drive engines and discouraging the practice of recycling gas to keep engines and compressors loaded. As the percentage of Canadian production coming from older depleted gas fields, low pressure shallow gas and natural gas from coal (NGC) increases, the energy and costs associated with compression for a given volume of sales gas will increase significantly, as shown in Figure 3.

Cost/Benefit – Assuming a potential savings of $400M with implementation of improve practices and controls, the cost to mitigate emissions would be approximately $800M with payouts ranging from of 1-1/2 in upstream to 4 years in transmission.

2.3 Flaring and Venting – Public concerns about gas flaring associated with light/medium oil production, and revenue loss/GHG concerns related to gas venting practices in non-thermal heavy oil and bitumen operations, have led to considerable pressure to reduce these streams. In Alberta considerable effort by the AEUB, supported by the Clean Air Strategic Alliance (www.casa.org), led to the development of a Flaring and Venting Guide which has resulted in large reductions in both flaring and venting. The results have exceeded voluntary targets, likely as a result of concurrent increases in natural gas prices. Most of the remaining reduction potential may be met by having producers increase gas conservation to the standards which are required in the revised AEUB AEUB Guide 60, to be implemented in 2006.

Quick Alta Facts:
• Already reduced by 40% between 2000 and 2003 saving = $115 M/yr
•More Still Possible:
• Current Average 95%
• If all conserved 98+% = 533,000 E3m3/yr (64%) = $110 M/yr @ $6/GJ

• One company responsible for 30% of Flaring and Venting



Source AEUB ST2004-60B

Figure 4 – Impacts and Remaining Gains in Conservation of Flare and Vent Gas

In 2003, one company was responsible for 30% of the flaring and venting and only conserved about 74% of their solution gas from oil operations. In 2004, the same company improved to 83% solution gas recovery and reduced their contribution to only 23% of the losses. These changes are generally being made using existing technologies, motivated by higher gas prices, better measurement of gas being flared and vented, and potential loss of oil revenues if operations are shut-in for non-compliance with the AEUB AEUB Guide 60 provisions.

Cost/Benefit – Assuming a potential savings of $175M with implementation of AEUB Guide 60 in Alberta and increased measurement in Saskatchewan, the cost to mitigate emissions would be around $350M at an assumed average payout of 2 years.

2.4 Heavy Oil Trucking – In the heavy oil and primary bitumen producing areas, a major energy use and cost is on transportation fuel for trucking the produced fluids (oil/bitumen, water and sand). With heavy oil, especially when sand is too thick to easily move in gathering lines, the lines could plug up and the flow could stop. This results in high costs and delays in production thus forcing a reliance on trucks to move production from individual well sites to central processing facilities and pipeline terminals. While truck emissions are generally assigned to the transportation sector, the energy use is an integral part of the production process and could double the energy intensity of this sector, vs. what has been estimated in past reports. In Figure 5, most of the operating cost areas have trucking cost as a component.

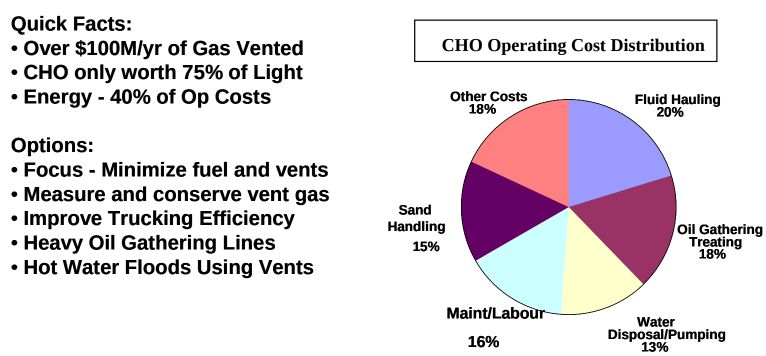


Figure 5 – Operating cost in a Conventional Heavy Oil (CHO) application.

Trucking also impacts road wear and tear (municipal and producer budgets), particulate emissions from road dust and diesel fuel, road safety, and production (due to road bans or weather). Work is needed to develop gathering options for heavy production. Gains could also be made by improved monitoring dispatch and efficiency in the trucking fleets and in optimizing the locations of oil processing and pipeline terminals in the producing regions.

Cost/Benefit – Potential savings by extending pipelines is difficult to estimate without more information but payouts would likely be on the order of 3 years. Shorter-term benefits with low capital in dispatching could be achieved earlier.

2.5 Improve Field Heaters – Most of the production from oil and gas wells passes through field facilities on its way to sales pipelines. In these facilities energy is consumed by treating gas or fluids to remove water, contaminants such as hydrogen sulphide or carbon dioxide or to recover hydrocarbon liquids. Most of this energy (aside from compression) is provided through burning natural gas in relatively simple, low cost and inefficient burners and heaters. When most of these heaters and burners were installed, energy efficiency was not a major consideration, as the fuel gas had no "on-the-books" value and, even if it did, the value would be very low compared to today's commercial natural gas prices. As a result many burners still use technology from the 1950's and overall thermal efficiencies may often be as low as 30-60%, vs. 80% for heaters using more efficient designs and improved (more expensive) controls. The poor control is amplified by the fact that heating energy needs generally decline as field production matures (in the case of gas) or more of the energy is spent heating increasing volumes of produced water (in the case of oil).

Quick Facts:
- **1979 fuel burned - 70 bcf/yr**
- **Cost est $320 M$/yr**
- **Usual efficiencies 30-60%**

Options:
- **Focus - Max Efficiency and**
  - **Reduce Heat Loads**
- **TEREE project to Improve Fire Tube Heaters underway**
- **Reduce water heating**
- **Shutdown unnecessary units**
- **Match heater size to load**

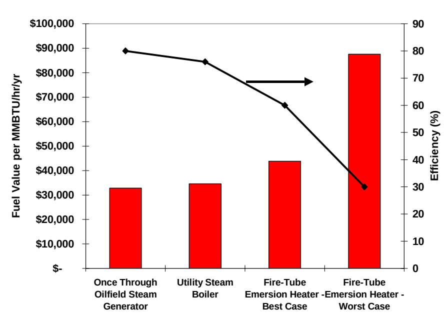


Figure 6 – Impact of Efficiency on Heating Costs

PTAC's Technology for Emission Reduction and Eco-Efficiency (TEREE) Committee has initiated a project to develop methods of retrofitting the lowest efficiency burners as an option to continuing operation at low efficiency.

Cost/Benefit – New heaters being installed will have higher efficiency, a major consideration in retrofit will be labour and downtime for older facilities. Payouts will likely range from months to 2-3 years, depending on the fuel used and current efficiencies.

2.6 Reduce Power Purchases – The highest cost energy used in the upstream oil and gas industry is electrical power, mainly for pumping oil and water. Currently, energy losses at the centralized power generation facilities are not included in industry energy intensities even though GHG emissions from power generation are included. The percentages indicated are rough estimates of the total amount of energy use that comes from externally generated power. Light oil uses the greatest amount mainly for producing and reinjecting produced water.

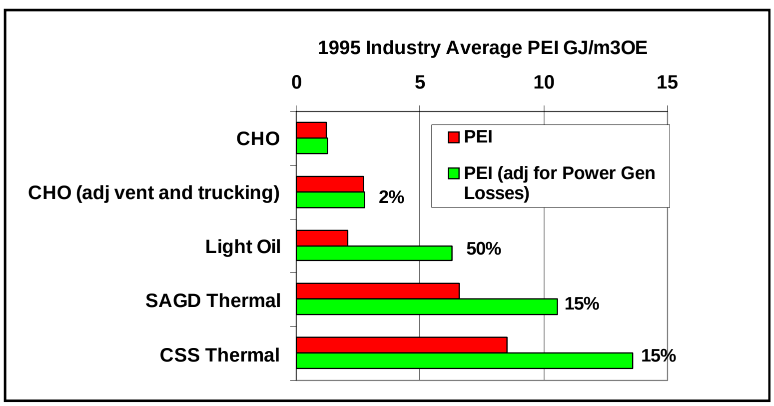


Figure 7 – Oil Production Energy Intensities with Estimated Adjustments for Losses at Power Generation Plants

With power costs being the largest "on-the-books" and highest cost per GJ energy source in conventional oil operations, it receives the highest amount of attention to reduce operating costs. While the economics for oil producers generating power for sale are poor vs. other oil and gas opportunities, the economics for backing out power purchases are much more attractive. As shown in Figures 8 and 9, distributed power generation from on-site produced gas also is less energy intensive than gathering, treating, compressing, pipelining and generating power at a centralized power generation site. Distributed generation also allows for on-site use of waste heat from generation (cogeneration) which further enhances the energy efficiency of this type of option.

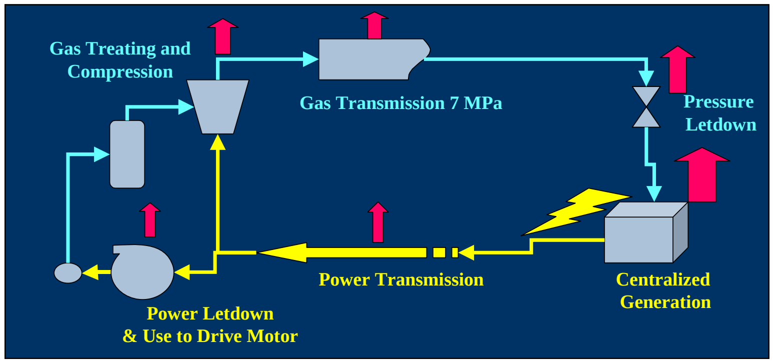


Figure 8 – Energy Losses with Centralized Gas Generated Power

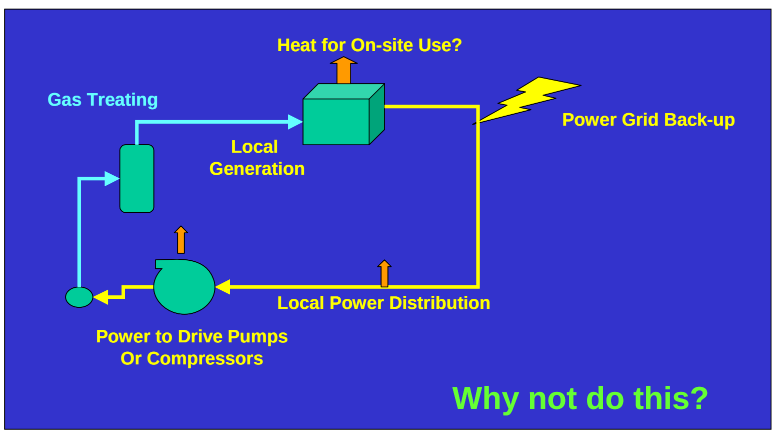


Figure 9 – Energy Losses with Decentralized Localized Power Generation

Cost/Benefit – Past efforts to generate power from flare gas were generally unsuccessful as: a) it is lower cost to reduce emissions rather than use them and b) systems are focused on power sales rather than on backing out power. Considerable cost and energy benefits would be found in generating power with produced solution gas and using that power for water disposal or artificial lift needs.

2.7 Other Conventional Oil & Gas – There are many other opportunities in the conventional oil and gas industry which could improve energy efficiency. As conventional oil and gas production are currently in decline, it is often assumed that energy consumption will drop over time. However, this is not the case as energy intensity will increase as enhanced oil and gas recovery methods are implemented.

Determining the most economic injectant for enhanced oil or gas production is a major factor in determining which to use. Usually the lowest cost injectant will also be the least energy intensive. Figure 10 shows a rough estimate of the relative cost and energy intensity of various injection fluids or gases. Normally, water injection and flooding will be the first process used to increase recovery over simply pumping (Primary Production) but it will only increase recovery by 5-20%. After water, some type of gas injection can further increase recovery but is more capital and energy intensive than water.

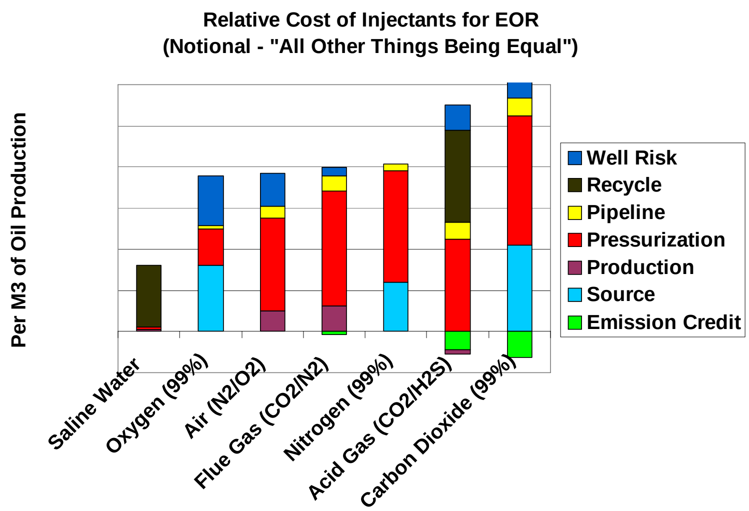


Figure 10 – Relative Cost/energy Intensities for Enhanced Oil or Gas Recovery

Cost/Benefit – Enhanced oil and gas recovery are still less energy intensive than oilsands production and the value of the products is higher. Even though these resources are declining recovery should be maximized before the wells and facilities are abandoned.

2.8 In-situ Oilsands – Currently, oilsands production is evenly split between mined and in-situ production, deeper, non-surface mineable resources form 96% of the total resource. Most resources will have to be recovered with some combination of thermal and chemical processes. Thermal processes generally require 1 unit of energy input for each 4 units of energy output but this ratio will become less favourable as lower quality oilsands are produced. Figure 11 shows an example of where input energy goes for a typical thermal heavy oil operation. Figure 12 shows an idealized, vision of what a lowest possible energy and emissions process might look like in a portion of the oilsands where the bitumen is contained in carbonate rock[1].

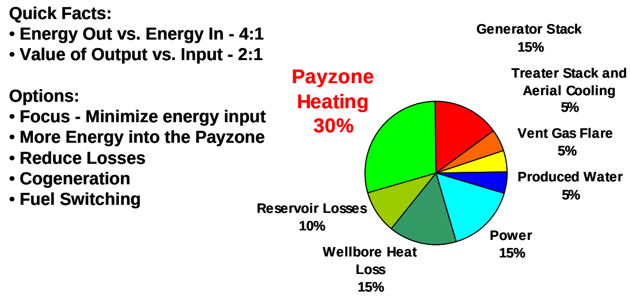


Figure 11 – Energy Consumption in a Typical Thermal Heavy Oil Operation

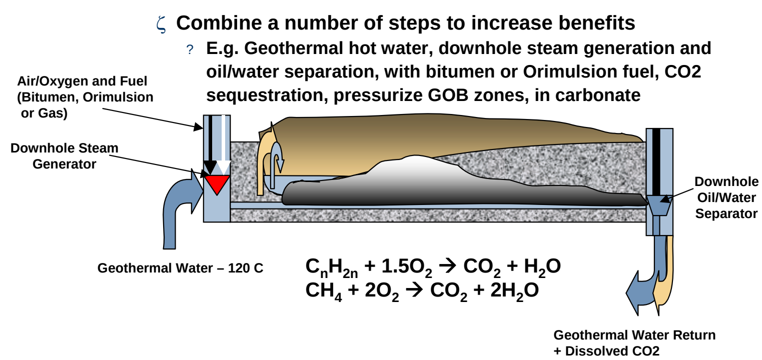


Figure 12 – Concept for Lowest Energy/Emissions Production of Bitumen

The process illustrated in Figure 12 could potentially reduce a number of the energy losses shown in Figure 11, to improve energy efficiency and reduce GHG and other emissions, at a potentially lower net cost. This process requires new R&D efforts to assess and develop the various process components.

1 See Report ""Expanding Heavy Oil and Bitumen Resources while Mitigating GHG Emissions and Increasing Sustainability - A Technology Roadmap" being prepared by PTAC for NRCan (CCTII), which should be available on PTAC's website www.ptac.org by May 31, 2006.

Cost/Benefit – Oilsands reserves are currently estimate at 28 billion m3 vs. conventional oil reserves of 0.25 billion m3 and an ultimate bitumen in place of over 270 billion m3 in the oilsands. Future energy efficiency will be much more crucial to oil and gas operations than it currently is.

3. Realizing the Prize

While producers who attended PTAC's Energy Efficiency Working Group session agreed there is likely a 10-15% energy prize that is economically possible, implementing options to realize the annual energy savings is not straightforward. As has been discussed earlier, simply having positive economics is not sufficient to motivate producers.

3.1 The Size of the Prize

In section 2, a number of opportunities were discussed which could lead to near and long-term substantial energy savings. Based on those areas, and some assumed levels of savings, PTAC estimates savings of approximately $1 billion/yr just in the conventional oil and gas sector, as follows:

- Compression - Monitoring and Control - Over $400 M/yr
    - Improve efficiency of engines and reduce recycle (15%)
- Flaring and Venting - Over $200 M/yr
    - Solution Gas conserved to 98+% for all companies
- Heavy Oil Trucking - Over $150 M/yr
    - Extend sales pipelines to reduce haul distances.
- Improve Field Heaters - Over $100 M/yr
    - Upgrade heaters and shutdown unnecessary heaters
- Reduce Power Purchases - Over $100 M/yr
    - Convert to more Distributed Power Generation
- Other Sources - Over $50 M/yr in addition to savings in conventional oil and gas. A further less defined $500 M/yr and growing energy efficiency prize is likely achievable in the emerging oilsands operation in three key areas:

- Cogeneration for Power and Heat
    - Already over 1,000 MW of Cogen (70-80% effective) in oilsands replacing coal power (30% effective)
    - Oilsands excellent locations for cogen as they need large amounts of power and heat
- Shift to lower cost "Off-the-books" energy
    - Energy self-sufficiency is the goal. On-site up-grader provides fuel for steam and power for mining and SAG-D

- Reduces energy needed to supply gas, power, etc.

- Process Efficiency Improvements
  - Continually needed as production moves into lower quality sands, which will increase energy intensity.

The order of magnitude of these potential savings has generally been supported by audit results available in the public domain.

3.2 Prize is of Low Net Value to Producers

An early point made in the Business Case Working Group is - while the prize is there, there is a cost associated with it and oil and gas producers have better opportunities to increase shareholder value. While there has not been a great deal of work determining the exact cost/benefit ratios, PTAC has proposed a tiered system of assessing prizes for conventional oil and gas efficiencies. The proposed tiers and a rough split of potential savings, costs and average payouts for conventional oil and gas operations are listed below:

- Tier 1 – Technically Achievable – Regulation Driven
  - Should already being in place or in transition with new regulations
  - Conventional Prize $175 M/yr → Cost $350 M (2 year payout)
  - Increased vent and flare gas savings due to new regulations in Alberta and Saskatchewan.
- Tier 2 – Low Hanging Fruit - <1 year payout
  - Mainly operational changes requiring no, or low, capital investment
  - Conventional Prize $185 M/yr → Cost $93 M (6 month payout)
  - Reduce recycle; equipment shutdown; reduced power use
- Tier 3 – Practically Achievable – 1-2 year payout
  - Increase recovery of oil, gas or other products, or decrease fuel costs.
  - Conventional Prize $300 M/yr → Cost $450 M (18 month payout)
  - Compression improvements; further vent gas reductions; improve heaters
- Tier 4 – Economically Achievable – Positive Economic Present Value

- o Generally the desire of resource owners (Provinces)
- o Conventional Prize $400 M/yr → Cost $1,200 M (3 year payout)
- o Extend Heavy Oil pipelines; compression; distributed generation

➢ Tier 5 – Technically Achievable – Negative Economic Present Value

- o Critical or have positive environmental, health or safety benefits.
- o Conventional Prize Small or Intangible → Cost $100M
- o Methane vent mitigation; reduce well test emissions

The above totals would indicate that a $1 b/yr savings in energy use in the conventional oil and gas industry could cost as little as $2.2 billion, as a one time expenditure, which is about 10% of the annual industry's total capital expenditures for development.

3.3 Demands for Efficiency – Primarily a Regulatory Push

The above analysis would appear to indicate that considerable savings could be achieved with an average 2 year payout on capital. In reality the higher demand for resources, human and financial, for energy efficiency projects will likely require a regulatory push. Producers currently allocate their resources based on internal priorities, which vary from company to company. Some producers routinely exceed potential regulatory requirements, but others live to the letter of the regulation and hold overall industry performance back.

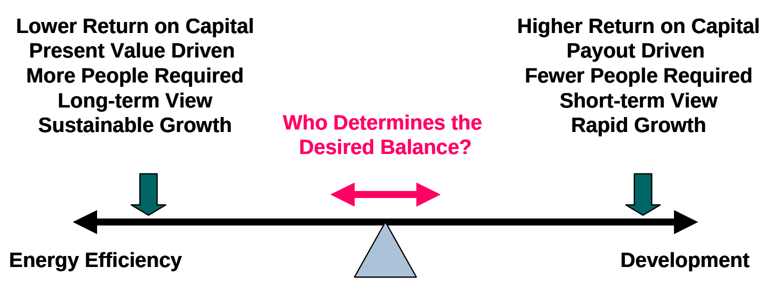


Figure 13 – Balance of Energy Efficiency vs. Development

Figure 13 illustrates the balance between energy efficiency is a difficult one for development mandated and motivated producers to initiate as a priority. If economic drivers don't favour energy efficiency, then there must be a regulatory push to ensure all producers are implementing change to meet long-term conservation and sustainability goals, just as they do for more toxic emissions.

3.4 Demands for Efficiency – Variable Investor Pull

Some producers are motivated by investors such as ethical funds and policies inspired by CEO champions. Most producer investors are more focused on "on-the-books" asset growth, cash flow and return on investment rather than "off-the-books" operating efficiencies. Figure 14 highlights this by showing the potential returns on investment which oil and gas producers can achieve based on current finding costs and risks for new development vs. energy efficiency investments. Often development is assumed to have high risk, however, due to the lack of energy measurement and uncertainties, energy efficiency projects may actually entail more risk and as many of the savings are "off-the-books" they are much more difficult to justify. In some cases investors won't have the information needed to make an informed decision in support of energy efficient producers.

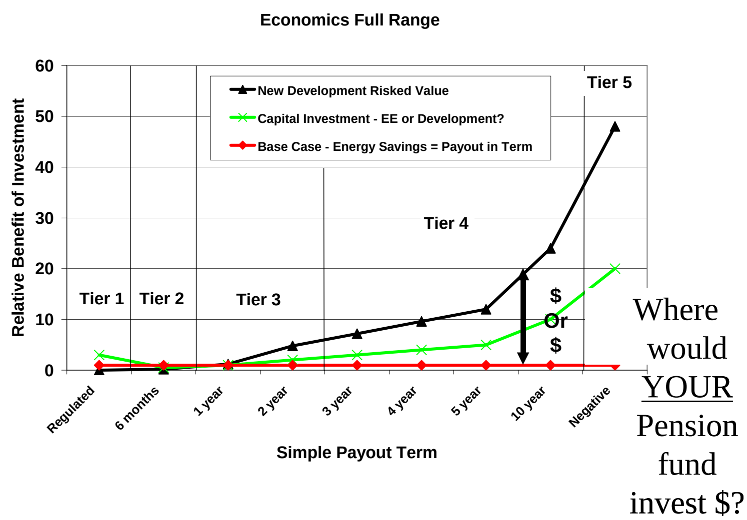


Figure 14 – Relative Returns on Capital Investment for Oil and Gas

As a result of the above discussion, all companies will pursue Tier 1 activities to avoid high impact regulatory actions; most will pursue Tier 2 projects; some companies will pursue Tier 3; and few, if any, will move into Tier 4 or 5 activities.

3.5 Existing Technology Solutions Awaiting Demand

There are very few cases where a lack of technology has really been a factor preventing mitigation of energy use, except as a function of the cost of the technology and the size of the prize associated with its use. To achieve a 6-12 month payout extremely low cost technologies are required. Despite the fact that existing economic solutions exist, that are widely used in downstream energy consuming industries where energy costs are higher, expected payouts are longer and all the energy costs are “on-the-books”. With such short payouts there is little incentive for technology vendors to lower prices or develop lower cost products as there would be little room left for their own profit. As a result existing technology solutions await the development of demand based on increased regulations.

3.6 Societal Costs of Investing in Energy Efficiency

Directionally, investing in energy efficiency may have some short-term impacts on energy supplies as some capital will be diverted from development. However, this impact is unlikely to be significant or noticeable to consumers against the backdrop of today’s wide swings in energy price due to natural and political events. In the long-term, impacts are a bit more significant as energy unnecessarily consumed today is energy that is unavailable for future generations. It may also cause long-term health or environmental issues such as global warming and climate change which are not sully understood today.

3.7 GHG and Energy Efficiency is the Same Driver

From an administrative point of view, the producers at the Working Group saw energy efficiency and GHG emissions as being so closely related, to such an extent, that separate measurements and policies for the two should not be required. This is generally true and the most economic energy efficiency measures will likely focus on reducing methane emissions which account for 40-50% of the industry’s GHG emissions[2]. Reducing fuel use can also have a significant impact on CO_2, NOx and other emissions, which are of higher concern to local residents and regulators

[2] See PTAC report on Fugitive Emissions prepared for the Industrial Energy Audit Incentive.

4. Conclusions and Recommendations

In summary, we have confirmed that there is a significant economic energy efficiency prize in the upstream oil and gas sector. However, it is a prize that has unique challenges. Due to energy costs being "off-the-books", and the current high demand and prices for increased production, industry is focusing most of their resources on development vs. energy efficiency.

4.1 Energy Efficiency Stewardship

Energy Efficiency stewardship is a key component of influencing conservation efforts but must reflect the varying interest of the key stakeholders as shown in Figure 15.

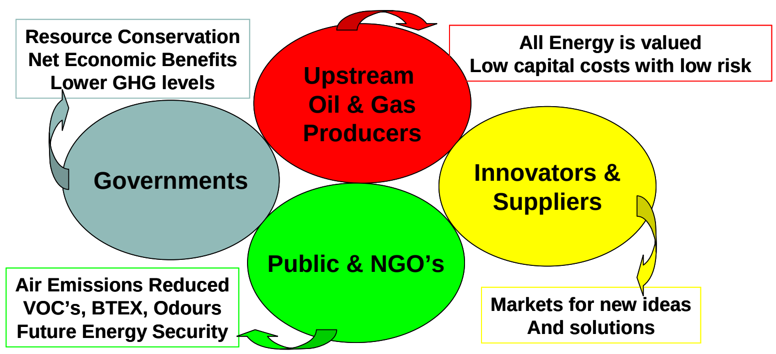


Figure 15 – Benefits of Energy Efficiency Vary by Stakeholder

- **Governments** must take responsibility for encouraging resource conservation through firmly encouraging actions which have net economic and environmental benefits for their various constituents and the global community.
- **Producers** have a fiduciary responsibility to their shareholders to steward how they balance increased growth and returns on investment against conserving energy assets which have an economic value and can be conserved at low cost and low risk.
- **Innovators and Suppliers** also have a responsibility to make returns for their owners to compensate expenditures on technology development, marketing and production for a relatively limited oil and gas market.

- **Public and NGO's** must steward the balance of sometimes conflicting messages they take to governments which seek increased conservation and mitigation of impacts while failing to address the potential costs.

4.2 Multi-Stakeholder Process for Setting Targets

To make progress in enhancing energy efficiency in upstream oil and gas operations, the same efforts are needed that have worked in the past, to reduce areas of concern such as toxic gas releases, spills and land use issues. Multi-stakeholder processes should involve participation from more than just governments and producers. They should ensure a balance by including public and service/supply representatives agreeing to concrete and measurable actions. Each group must take responsibility for issues under their control with the five major outcomes shown in Figure 16.

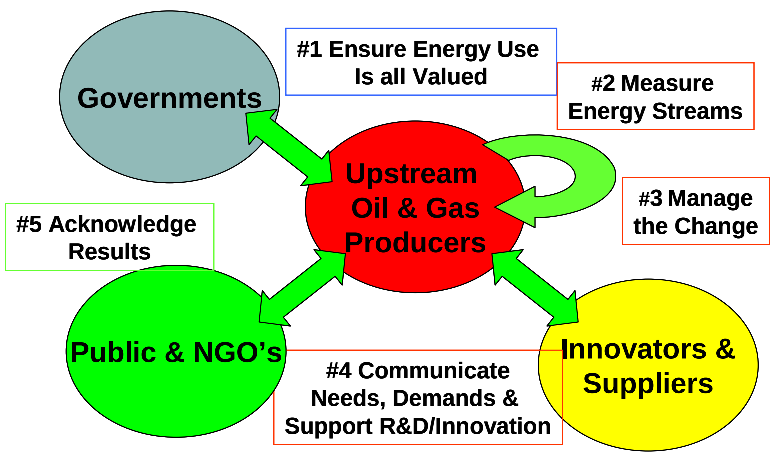


Figure 16 – Initial Steps to Encourage Energy Efficiency

- Governments – must ensure all energy used has a value and is valued.
- Producers – must measure the energy streams to better define the prizes and allow appropriate management of changes required to conserve energy. They must clearly communicate their needs to Innovators and Suppliers so the most appropriate technologies can be developed, selected and utilized.

- Public and NGO's – must support change by not only pointing out areas for improvement but also in acknowledging results when real improvements are achieved by producers.

4.3 Wait and See as a Strategy

Without concrete actions to initiate and support change, i.e. taking a wait and see attitude, there will be a significant impact through loss of valuable energy resources and higher air emissions from upstream oil and gas operations. Ultimately energy use will drop, but only as a result of the energy resources being depleted. To help delay the ultimate depletion of oil and gas resources potential steps focus mainly on:

- **Provincial Regulation** – Regulations are the easiest to implement and consistently provide motivation for energy efficiency changes in oil and gas operations. The provinces not only gain from conserving energy to produce future benefits and revenues, they also gain by avoiding future health or other costs which may result from higher emissions. As has been shown, the investments needed will not "kill the golden goose", but will serve to enhance its future productivity as fossil fuel production energy intensities increase.

- **Increased Measurement and Monitoring** – Facility operators and producer management require more and higher quality information on energy use to allow them to make responsible conservation decisions and implement mitigation activities. Many savings will be recognized from low cost operational changes, which are currently undetected, or only detected when they turn into significant release events. Without measurement there cannot be any reasonable and effective management or stewardship of energy use.

- **Clear Government Policy** – In some cases, government policy uncertainty may be delaying action. Many organizations are concerned about their early actions being under-valued, or worse, being penalized by policy changes that ignore the positive actions of industry champions.