GREENHOUSE GAS EMISSION INVENTORY

Penn West Energy Trust

2008 Annual Progress Report

September 11, 2009

Table of Contents

Figures

Tables

1 Company Information

Penn West Energy Trust
Suite 200, 207 - 9th Ave SW
Calgary, Alberta
T2P 1K3
Phone: (403) 777-2500
Facsimile: (403) 777-2699
www.pennwest.com

Executive Contact: William E. Andrew, President and CEO

Environmental Contact: Tim Sullivan, Environmental Stewardship Coordinator

Penn West Energy Trust (here after called "Penn West") is a rapidly growing senior independent oil and gas producer involved in exploration, production and processing of petroleum reserves in western Canada. Penn West's production efforts are focused in the areas of the Western Canadian Sedimentary Basin as shown in Figure 1.1. Penn West operates a suite of high-quality conventional and unconventional projects with mid to long-term exploration, development and enhanced recovery potential. We are building our future through appropriate field development, prudent financial management and strategic acquisitions. In 2007, Penn West acquired Vault Energy Trust which increased production. In 2007, total production was approximately 127,098[1] barrels of oil equivalent per day (20,207 m^3/d).

[1] This volume accounts for ownership percentage from operated and non-operated production facilities, whereas, the production volume presented in Table 3-1 represents gross production from operated facilities only.

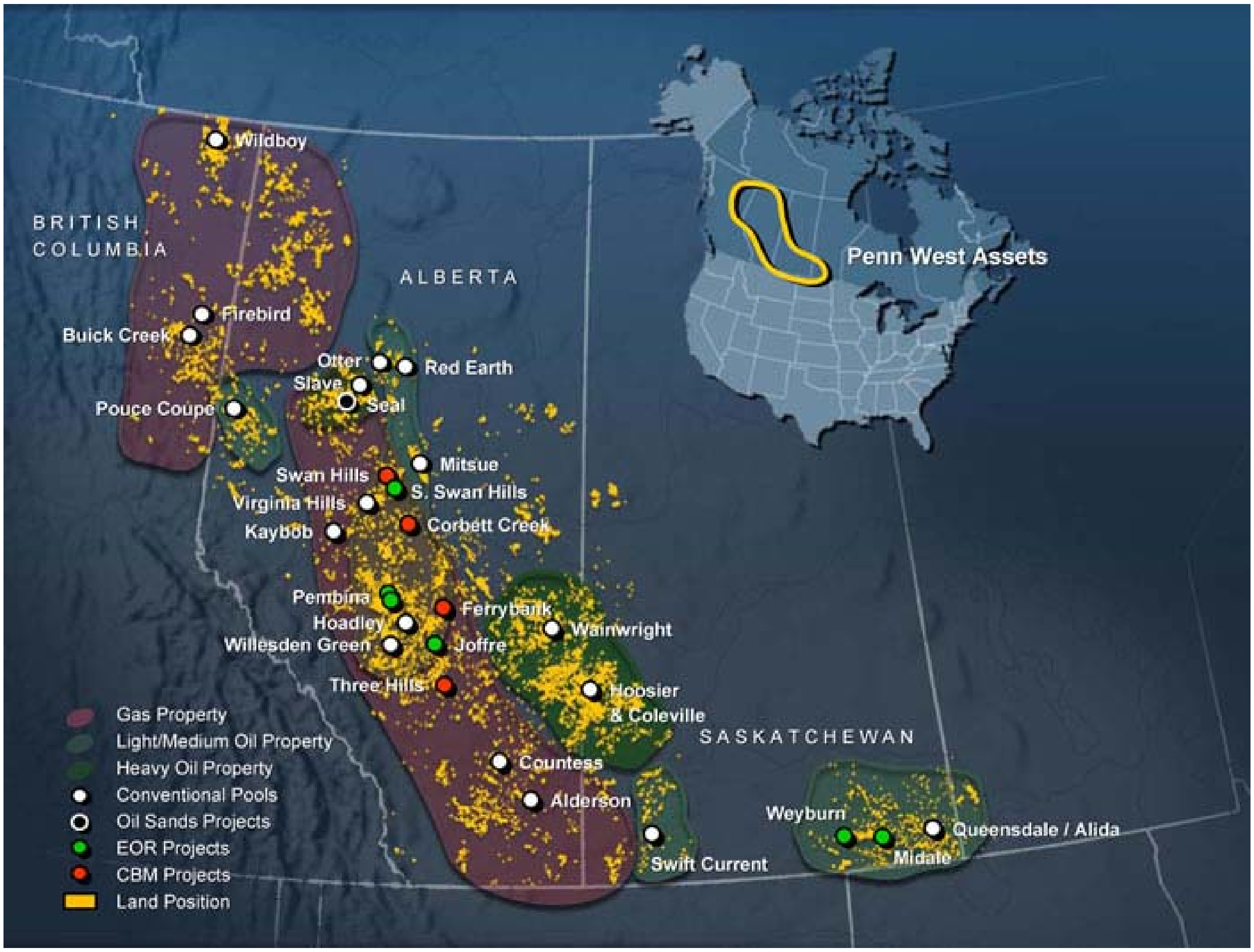


Figure 1.1 Penn West Core Production Areas

2 Corporate Commitment

Penn West is committed to minimizing the impact of its activities on the environment wherever it operates. In keeping with our commitment, Penn West has instituted controls and procedures with respect to environmental protection in accordance with the *Environmental Operating Practices for the Upstream Petroleum Industry* published by the Canadian Association of Petroleum Producers (CAPP). Penn West also strongly supports the concept of voluntary measures as a means of achieving Canada's greenhouse gas (GHG) emission objectives. As part of our commitment to the Environment, GHG issues have been included in Penn West's *Environmental Management Plan* and *Environmental Operating Guidelines.* These are the basic documents that define how Penn West conducts its business with respect to the environment.

Penn West's efforts with regard to GHG emissions and climate change have focused on three primary objectives:

2.1 Education

Penn West has prepared an educational document that summarizes the available information regarding the science of climate change and the effects of global warming on our environment. A series of informal seminars and emission management sessions have been conducted to present this information to upper management, engineering staff and field personnel. This education program is an ongoing process with periodic review and training, as required for Penn West employees and contractors involved in GHG reduction programs.

2.2 Involvement of All Company Personnel

Greenhouse gas issues are routinely discussed during production meetings, especially in the context of improvements in energy efficiency. The ongoing education program is intended to increase awareness of GHG related issues and further involve field personnel in developing practical and cost effective strategies for reducing GHG emissions. Additionally, major suppliers of production equipment are a significant part of this strategy. Penn West tracks GHG emission reductions using a system that was first implemented in 1998. This system continues to provide valuable information regarding projects which result in improved energy efficiency and GHG emission improvements. Whenever a project is implemented, field personnel complete a standardized form that documents the project’s implementation date, a brief description of the project, and any measured, or anticipated, increases or reductions in fuel gas consumption, flared or vented gas volumes and electric power consumption.

These forms are forwarded to a central location. Emission reductions are calculated and tabulated for inclusion in this report. Summaries of completed projects are periodically distributed to field personnel to provide feedback on which types of projects are most effective in reducing GHG emissions and what has been implemented in other field areas.

Overall GHG emission reduction is one of the key indicators (along with capital cost, payout period, regulatory requirements, etc.) used by Penn West to assess the viability of proposed projects. In some cases, projects that are marginal or even uneconomic will be considered if the GHG emission reductions are particularly large.

The GHG emission reduction target, set out in this and previous GHG Progress Reports, is reviewed periodically by Penn West’s environmental and management staff to ensure that the company is on track to achieve its goals. The responsibility for achieving our target GHG emission level extends from Penn West’s President and CEO, William E. Andrew, to the head office and operations personnel that report to him.

2.3 Greenhouse Gas Emission Control Strategies

Considerable progress has been made toward the implementation and evaluation of a wide variety of GHG emission reduction projects. While most of the projects implemented make good economic sense in their own right, Penn West also considers projects with longer payout periods, if the GHG emission reductions are significant. Details of the actions taken in 2007 and those planned for 2008 are described in Section 4. Section 4.1 provides a brief analysis of the GHG emission reductions made in 2007 and proposed in 2008 in order to illustrate our progress toward meeting these goals.

3 2007 Greenhouse Gas Emission Inventory

An inventory of Penn West's GHG emissions for 2007 has been compiled to help illustrate progress towards the stabilization of GHG emissions from our operations. The inventory draws upon ISO 14064-1 and CAPP GHG quantification methodology and includes the following steps:

1. Identify GHG sources included in the inventory.
2. Describe the collection of GHG activity data.
3. Describe the methodology employed.
4. Describe the baseline methodology.
5. Discuss performance indicators.
6. Describe the uncertainty analysis.
7. Present summary of GHG emission inventory results.

3.1 GHG Sources

Penn West is engaged in the production and processing of crude oil and natural gas. As such, sources contributing GHG emissions are related to the upstream oil and gas activities identified in Figure 3.1.

Operations highlighted in gray, within the dashed line, are included in Penn West's GHG inventory. This inventory boundary was designed to capture the majority of GHG emissions under control of Penn West and take advantage of readily available data. In this manner, data collection efforts can provide the most comprehensive and accurate inventory possible given finite project resources. GHG contributions from processes falling outside the dashed line are considered either small relative to the total inventory or not controlled by Penn West (CAPP, 2004).

The inventory boundary includes only those facilities operated by Penn West (non-operated facilities are excluded from the inventory) in Canada. Therefore, production values in this inventory represent gross production values and do not reflect Penn West's ownership fraction of a particular facility. This approach was taken because:

- Access to the necessary data is straightforward and can be easily verified at a later date.
- Likelihood for double counting is reduced.
- As the operator, Penn West is responsible for the operation, maintenance and any efficiency improvements at the facility.
- The Canadian GHG Registry and ISO 14061 focus on control of a facility rather than ownership.

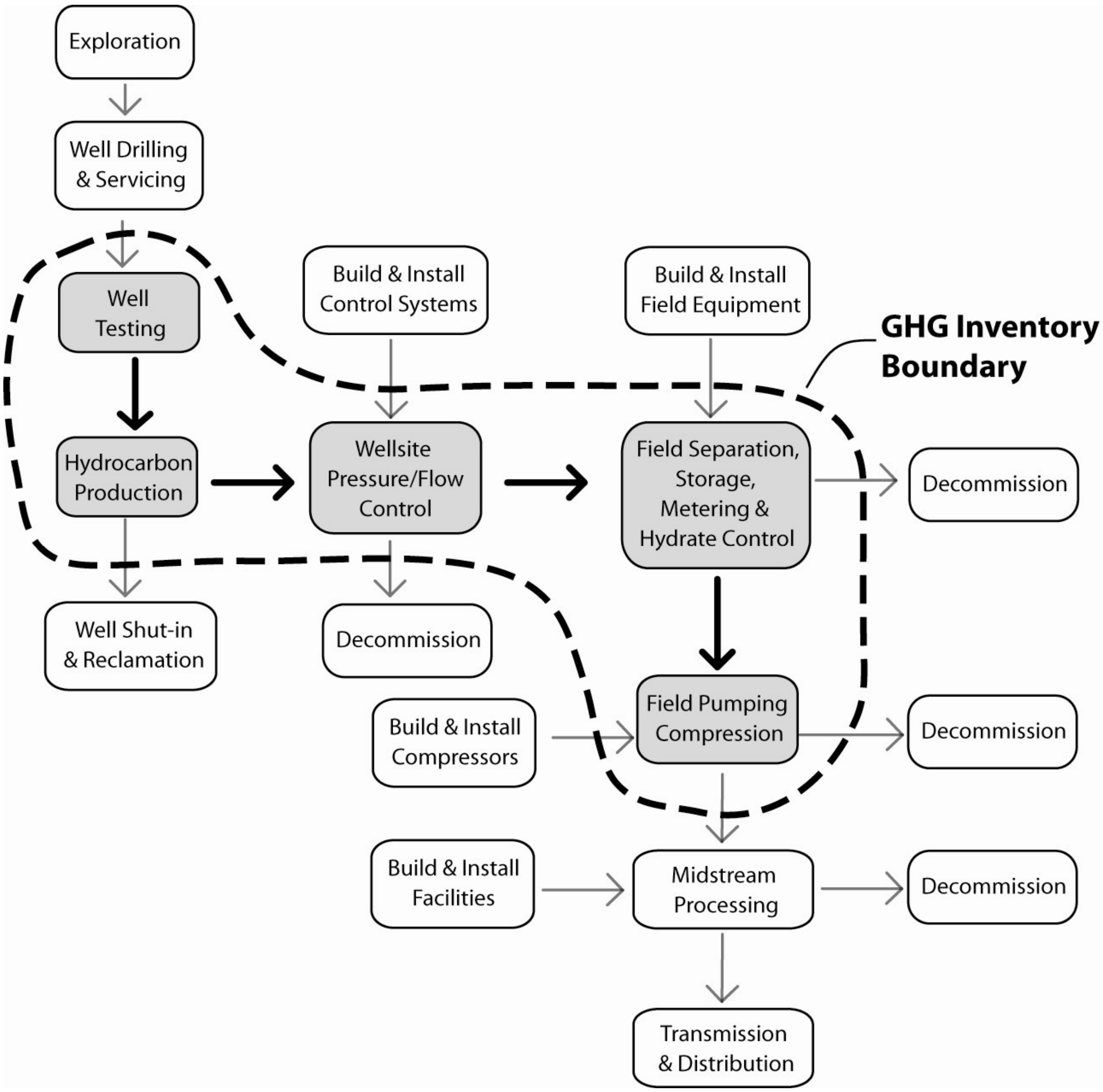


Figure 3.1 Inventory Boundary for the Selection of GHG Sources

3.2 Production and Energy Usage Data

The preparation of Penn West's 2007 GHG emission inventory uses production accounting data submitted to the Alberta Energy Resource Conservation Board (ERCB) and from company records for British Columbia, Saskatchewan and Manitoba as well as regulatory reports submitted to the ERCB, the Saskatchewan Department of Industry and Resources (SIR), the British Columbia Oil and Gas Commission (OGC), the Manitoba Science, Technology, Energy and Mines (STEM) and company equipment databases. Data for Penn West's operated wells, batteries, gas gathering systems and gas plants in Alberta, Saskatchewan, Manitoba and British Columbia have been used to develop the emissions inventory. Production and disposition data includes: oil and gas production, oil and gas delivery, fuel gas, flared and vented volumes. Energy usage and emissions from the activities of contractors, fleet vehicles and the Calgary head office are considered outside the inventory boundary presented in Figure 3.1 and therefore not included.

3.3 Emissions Evaluation Methodology

A bottom-up methodology has been employed whereby emissions data is calculated for individual sources at each Penn West operated facility within the inventory boundary defined in Figure 3.1. Company totals are then obtained by aggregating emissions from each facility. The various activities causing GHG emissions are evaluated as described in the following sections. The inventory accounts for GHG emissions from combustion activities, flaring and venting of waste gas, process venting, fugitive equipment leaks, indirect emissions from electrical consumption, CO_2 venting, storage losses and glycol dehydrator off-gas.

The emission activities considered are described in the following sections. In each case, emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are assessed as applicable, and the total GHG emissions are presented in terms of equivalent carbon dioxide (CO_2E) emissions based on current global warming potentials (i.e., 1.0 for CO_2, 21.0 for CH_4 and 310 for N_2O). Emissions calculations are limited to these three GHGs as the predominant source of Penn West's emissions result from natural gas combustion and processing where other GHGs, such as CFCs and SF_6 are not a byproduct of normal operations or a feedstock material and are therefore not expected to be present.

All emission calculations have been performed using a custom database application that meets or exceeds existing GHG reporting standards. The emission assumptions and methods of calculation are consistent with the methodologies outlined in the CAPP Guide *Calculating Greenhouse Gas Emissions*.

Note: Emission inventories prior to 2002 were prepared using a modified version of the CAPP short-form methodology. Emission values for 2002 and beyond are considered more accurate because of the facility based methodology and more rigorous reporting of fuel consumption, flaring and venting by production accounting departments.

3.3.1 Combustion Activities

For all major facilities, inventories of natural gas fired equipment were prepared based on Alberta Environment annual reports, surveys sent out to field operation supervisors and Penn West company equipment inventories.

Greenhouse gas emissions from combustion sources arise primarily from fuel usage during the production and processing of crude oil, natural gas, and by flaring of waste gas. Natural gas accounts for the majority of the fuel consumed in the upstream oil and gas industry and volumes are reported to the ERCB in Alberta, SIR in Saskatchewan and the OGC in British Columbia on a monthly basis. Purchased propane and diesel fuel consumption is also included but is only a minor contribution to combustion emissions.

Greenhouse gas emissions from combustion sources at each Penn West operated facility have been estimated based on these reported volumes and average emission factors for the types of equipment in use (U.S. EPA, 1995, manufactures' data). The amount of fuel consumed is prorated to each gas-fired process unit (e.g., reciprocating compressor, process boiler, etc.) based on the rated power, typical loads and thermal efficiencies for each unit.

3.3.2 Process Venting

The process venting category accounts for all activities that vent natural gas directly to the atmosphere. These activities include: heavy oil well casing gas venting, the use of natural gas as the supply medium for pneumatic instrument controllers, blowdown or process equipment for maintenance or emergency pressure relief, surface casing vent blows, use of gas-operated chemical injection pumps, use of natural gas to start compressor drivers, etc.

The volume of gas vented from heavy oil well casings is generally estimated based on heavy oil production and a measured or estimated gas-to-oil ratio (GOR).

Because of the small volumes of natural gas that are vented by instrument controllers and chemical injection pumps and the infrequent or emergency nature of large releases, accurate vented volumes are not always available. Emissions from pneumatic instrument controllers and chemical injection pumps, therefore, have been assessed by applying industry average emission factors for these types of equipment (CAPP, 1999) to the number of each equipment type at each site. Due to the uncertainty associated with estimating the rate of release, the number of events and the duration of each event, emissions from emergency pressure relief and blowdowns have not been estimated, and rely solely on those volumes reported to the ERCB in Alberta and on facility estimates outside of Alberta.

3.3.3 Fugitive Equipment Leaks

Fugitive equipment leaks are emissions from equipment components that leak as a result of wear, poor design or improper installation. The primary emission sources include but are not limited to: threaded and flanged connections, valve stem packing leaks, leakage past valve seats to the atmosphere, compressor seals, pump seals, pressure regulator vents and sampling ports.

Emissions from fugitive equipment leaks at each of the facilities were estimated by applying average emission factors to typical equipment component counts for every process unit at each facility based on field surveys and standard design practices (CAPP, 2004). The calculated emissions have been speciated using typical gas compositions for the process streams encountered at upstream oil and gas facilities.

GHG emissions from fugitive equipment leaks are calculated using facility equipment counts and average emission factors. The uncertainty associated with this calculation can be very high, up to ± 50 percent, due to the uncertainty in the number of leaking components and the distribution of leak rates. By contrast, the uncertainty in the emission estimate of CO_2 from stationary fuel combustion is approximately ± 8 percent. Consequently, the fugitive emission numbers should be used with caution.

3.3.4 Formation Carbon Dioxide Venting

Formation carbon dioxide emissions result from sour gas sweetening. The volume of CO_2 vented at each sour gas processing facility was estimated based on either acid gas volumes provided on production accounting reports and the average CO_2 concentration of acid gas stream or the total sour gas production and the inlet CO_2 concentration of sour gas.

3.3.5 Indirect Emissions

While electric power consumption does not result in any GHG emissions at the point of consumption, if the power is produced at fossil-fuel fired generating stations, there are GHG emissions emitted at the power plant. It is common practice for facilities to account for GHG emissions associated with the generation of the electric power they consume. These “indirect emissions” are calculated based on the total electric power consumed by the facility and on provincial average emission factors for power generation (CAPP, 2003).

3.3.6 Storage Tanks

Storage tanks can emit greenhouse gases as a result of both normal evaporation and from product flashing. Evaporative losses occur when volatile hydrocarbon products, which are stored in tanks, are vented to the atmosphere. As the product evaporates, the vapour space in the tank becomes saturated. These vapours are expelled during tank filling (working losses) and due to diurnal temperature and pressure changes (breathing losses). Any CH_4 or CO_2 present in the released volume will result in GHG emissions. Greenhouse gas emissions from evaporative losses are generally very small due to the low concentrations of methane and carbon dioxide in the stored products.

Flashing losses can, however, be a significant source of GHG emissions. Produced hydrocarbon liquids at production facilities frequently contain a certain amount of gas in solution. The amount is determined by the temperature and pressure of the first vessel upstream of the stock tanks. When the product enters the tank, the solution gas flashes or boils off and is released to the atmosphere.

Storage emissions have been evaluated based on the volumes of hydrocarbons produced (from production accounting information), the number and types of storage tanks at each facility, and information regarding whether the stored hydrocarbon liquid is a "wild" (i.e. contains solution gas) or "weathered/stabilized" product. Evaporative losses have been estimated using the U.S. EPA Tanks 4.08 (U.S. EPA, 1995) model. Flashing losses have been assessed by performing a flash calculation at the temperature and pressure of the last vessel upstream of the storage tanks to estimate how much gas is absorbed in the oil.

3.3.7 Glycol Dehydrators

Glycol dehydrators are sources of GHG emissions from both the reboiler still column and the use of gas operated glycol pumps. In the dehydration process, glycol is contacted with the wet gas stream to absorb water. In addition to water, the glycol has a tendency to absorb small amounts of hydrocarbons (primarily benzene, hexane and heavier hydrocarbons, with some methane). When the glycol is regenerated in the reboiler, the water and residual hydrocarbons not released in the flash tank are liberated and vented to the atmosphere.

Most field glycol dehydrators employ an energy exchange pump to circulate glycol from the reboiler to the contactor tower. The energy in the rich glycol leaving the bottom of the contactor is used to pump the lean glycol back into the top of the contactor tower. A small amount of wet gas also passes through the glycol pump and is subsequently vented from the top of the reboiler still column. Greenhouse gas emissions from glycol dehydrators have been estimated using Penn West's detailed dehydrator inventory as per legislative regulations.

Emissions calculations are based on rigorous process simulations that determine still column off-gas emissions based on observed operating conditions. Glycol dehydrators located at gas processing plants typically use electric glycol circulation pumps, instead of gas-drive units, to minimize venting emissions.

3.4 Base Year Quantification

The CAPP Short Form Method was used to establish 1996 baseline GHG Emissions.[2] This methodology was employed because it was the industry's best practice when Penn West began calculating GHG inventories in 1997. Updating baseline values with the facility based, bottom-up methodology currently used is difficult due the inaccessibility of historical facility level production and equipment data.

Penn West's total estimated GHG emissions for the baseline year 1996 are 576,055 t CO_2E.

3.5 Establishing Performance Indicators

The Production Energy Intensity Index or PEI (GJ/m^3 oil equivalent production) for Penn West's operations has been calculated to compare energy usage per unit of production for each period. Similarly, the Production Carbon Intensity Index or PCI (t CO_2E/m^3 oil equivalent production) tracks the GHG emissions per unit of production. These key performance indicators compare the overall production volumes to energy usage and emissions while providing a basis for comparing the efficiency of Penn West operations between periods. Historical PCI and PEI values and a discussion of Penn West's 2007 indices can be found in Table 3.1 and Section 3.7, respectively.

While energy and carbon intensity are very dependent on a company's production mix (i.e., heavy oil production typically have higher PEI and PCI than sweet natural gas production), it does allow improvements in energy efficiency and emission reduction projects to be tracked. Therefore, PEI and PCI are best used to gauge performance improvements with respect to the Baseline Year. However, if a company's production mix changes significantly, corresponding changes in PEI and PCI can be expected which are not necessarily reflective of changing energy efficiency.

3.6 Uncertainties

The uncertainties in the presented emission estimates were calculated in accordance with the Tier-1 procedures delineated by the Intergovernmental Panel

[2] Uncertainties for 1996 through 2001 are not available, due to the short-form methodology that was used

on Climate Change (IPCC) in its *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. This is a bottom-up method in which the uncertainties in the emission estimates for individual sources are estimated based on the uncertainty in the applied emission factor and activity data. The source-level uncertainties are then combined as the sources are "rolled-up" from process units through to facilities and finally to the company level to determine the overall inventory uncertainty. The management of uncertainties in GHG emission estimates is an important part of developing a sensible strategy for managing GHG emissions.

3.7 Emission Summary

Summaries of Penn West's GHG emissions by pollutant, energy consumption, production, and emission and energy intensities are presented in Table 3.1. The percentage change since 1996, Penn West's baseline year, is also provided. GHG emissions are presented by source type in Table 3.1. Fugitive leaks and other losses presented in Table 3.2 include dehydrator off-gas emissions, equipment leaks and storage losses.

GHG emissions increased in 2007, primarily due to the acquisition of new facilities but also because of better accounting practices. A total of 3,221 kt of CO_2E were emitted by Penn West operated facilities in 2007, an increase of 48 percent from 2006 emissions and an increase of 459 percent over the baseline year (1996). Similarly, absolute quantities of CO_2, CH_4 and N_2O have increased by 416, 555 and 508 percent, respectively (Figure 3.2). By including offsets achieved through sequestering CO_2 at the Joffre, Pembina, Weyburn, and Midale CO_2 Injection Projects in the 2007 inventory, the total CO_2E emissions, less offsets become 2,711 kt CO_2E or about 372 percent higher than the baseline. The increase in absolute GHG emissions from the base year results from growth due to acquisitions and the trend towards more energy intensive production techniques due to declining reserves. Of the total CO_2E emissions, the largest contributor is due to the combustion fuel gas and waste gas accounting for 33.8 percent of GHG emissions. The remainder is divided among electric power consumption at 27.8 percent, venting at 20.1 percent, fugitive leaks and other losses at 12.4 percent and formation CO_2 venting at 3.5percent.

Penn West's energy consumption was 22,978 TJ in 2007, a 36 percent increase over the energy consumption in 2006, and a 320 percent increase over the baseline level of 5,466 TJ in 1996. Energy consumption is attributed to fuel gas combustion (71.7 percent), waste gas flaring/venting (13.3 percent) and electric power consumption (15.0 percent).

To track Penn West's progress towards our GHG emission goal, a series of benchmarking indices have been calculated and are presented in Table 3.1. Penn West's total production of hydrocarbon products from operated facilities in 2007 was $10,158 \times 10^3$ m^3 Oil Equivalent (OE). GHG emissions per unit production

(PCI) and energy consumption per unit production (PEI) are 0.3171 t CO_2E/m^3 OE and 2.262 GJ/m^3 OE, respectively.

Penn West has demonstrated a 3.3 percent decrease in the PEI and only a 28.6 percent increase in PCI relative to the baseline. If the CO_2 sequestration offset realized through the Joffre, Pembina, Weyburn, and Midale CO_2 Injection Projects are included in the PCI calculation, the GHG emissions per unit production would decrease to 0.2669 t CO_2E/m^3 OE (only 8.3 percent above the baseline).

Figure 3.3 presents CO_2E emissions by source type for 1996 and 2007. The general trend toward increased heavy oil production is evident in the charts. Venting makes up a larger proportion of total emissions in 2007 than in previous years. Likewise, the electrification of heavy oil wells has resulted in higher indirect emissions from electric power consumption.

Table 3-1: Summary of Penn West GHG emissions, production and energy usage													
	1996 Base Year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**% Change from 1996**
CO_2 Emissions (tonnes)	394,740	414,996	430,727	509,335	717,375	755,142	998,162	1,314,109	1,388,504	1,341,207	1,548,287	2,035,874	415.8
Uncertainty in CO_2 Emission Estimate (%)	N/A	N/A	N/A	N/A	N/A	N/A	+2.5;-2.5	+4.4;-4.4	+6.7;-6.8	+7;-7.1	+7.6;-7.7	+5.8;-5.8	N/A
CH_4 Emissions (tonnes)	8,436	8,944	10,179	13,469	16,944	19,065	22,465	23,663	25,262	22,538	28,787	55,226	554.6
Uncertainty in CH_4 Emission Estimate (%)	N/A	N/A	N/A	N/A	N/A	N/A	+9.5;-2.5	+11.1;-3.6	+3.4;-2.9	+3.5;-2.6	+3.2;-1.6	+1.9;-0.7	N/A
N_2O Emissions (tonnes)	13.44	15.20	16.76	20.24	32.78	33.94	56.71	81.31	74.78	73.10	80.05	81.67	507.7
Uncertainty in N_2O Emission Estimate (%)	N/A	N/A	N/A	N/A	N/A	N/A	+86.6;-2.9	+86.6;-2.9	+116.1;-6.8	+120.7;-7	+131.2;-7.6	+17.6;-1	N/A
Total CO_2E Emissions From All Sources (tonnes)	576,055	607,523	644,533	798,447	1,083,358	1,166,034	1,487,517	1,836,238	1,942,184	1,837,166	2,177,637	3,220,939	459.1
Uncertainty in CO_2E Emission Estimate (%)	N/A	N/A	N/A	N/A	N/A	N/A	+4;-1.8	+4.9;-3.1	+5.1;-4.9	+5.4;-5.2	+5.7;-5.5	+3.8;-3.7	N/A
CO_2E Offset from CO_2 Injection (tonnes)	0.0	0.0	0.0	0.0	0.0	12,250	47,022	34,096	43,214	72,400	260,131	509,810	N/A
Net CO_2E Emissions From All Sources (tonnes)	576,055	607,523	644,533	798,447	1,083,358	1,153,784	1,440,495	1,802,142	1,898,970	1,764,766	1,917,506	2,711,129	371
Energy Usage (TJ)[1]	5,466	5,511	5,876	7,055	10,725	10,843	13,783	14,340	16,737	15,084	16,903	22,978	320.4
Production (10^3 m^3 oil eq)2	2,337	2,583	2,658	3,265	4,520	5,190	5,624	5,852	5,883	5,246	7,042	10,158	334.7

Table 3-1: Summary of Penn West GHG emissions, production and energy usage

	1996 Base Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	% Change from 1996
CO_2 Index ($t\ CO_2/m^3$ OE) (w/wo offset)	0.1689	0.1607	0.1620	0.1560	0.1587	0.1431/0.1455	0.1691 / 0.1775	0.2187 / 0.2246	0.2287 / 0.236	0.2419 / 0.2557	0.1829 / 0.2199	0.1502 / 0.2004	-11.1
CH_4 Index ($t\ CH_4/m^3$ OE)	0.0036	0.0035	0.0038	0.0041	0.0037	0.0037	0.0040	0.0040	0.0043	0.0043	0.0041	0.0054	50.6
N_2O Index ($t\ N_2O/m^3$ OE)	5.751E-06	5.885E-06	6.305E-06	6.199E-06	7.252E-06	6.540E-06	1.008E-05	1.389E-05	1.271E-05	1.394E-05	1.137E-05	8.040E-06	39.8
CO_2E Index - PCI ($t\ CO_2E/m^3$ OE) (w/wo offset)	0.2465	0.2352	0.2425	0.2445	0.2397	0.2223 / 0.2247	0.2561 / 0.2645	0.308 / 0.3138	0.3228 / 0.3302	0.3364 / 0.3502	0.2723 / 0.3092	0.2669 / 0.3171	8.3
Energy Index – PEI (GJ/m^3 OE)	2.339	2.134	2.211	2.161	2.373	2.089	2.451	2.451	2.845	2.875	2.400	2.262	-3.3

[1] Energy usage is calculated from the energy content of fuel gas consumed, waste gas flared or vented, and electric power purchased.
[2] A summary of CO_2 sequestration projects is presented in Table 4.1
[3] Oil-equivalent volumes are calculated based on energy content (i.e., 37.4 GJ per 1000 m^3 of natural gas, 38.5 GJ per m^3 of conventional oil and 41.4 GJ per m^3 of heavy oil). This differs slightly from the boe calculation where six mscf is equivalent to one barrel of oil (i.e., 6 mscf = 1 boe)

Table 3-2: Summary of GHG emissions presented by pollutant and type of emission source

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 Emissions (t/yr)												
Combustion	252,642	251,197	271,417	328,804	502,659	501,260	589,510	680,349	728,659	676,601	752,814	1,040,258
Electric Power Consumption	100,104	114,182	115,220	143,431	169,535	191,240	336,975	545,944	571,165	593,839	733,761	878,680
Fugitive Leaks and Other Losses	354	370	404	526	645	744	622	617	414	489	630	2,048
Formation CO_2	41,624	49,233	43,703	36,556	44,469	47,812	30,025	86,593	87,080	69,168	60,109	113,542
Venting	16	13	14	18	67	14,086	41,030	606	1,186	1,109	973	1,347
Total CO_2	394.740	414.996	430.758	509.335	717.376	755.142	998.162	1,314.109	1,388.504	1,341.207	1,548.287	2,035.874
CH_4 Emissions (t/yr)												
Combustion	1,088	1,079	1,153	1,379	2,093	2,092	4,590	5,720	2,560	2,307	2,255	1,670
Electric Power Consumption	201	216	209	258	10	11	21	90	92	93	103	156
Fugitive Leaks and Other Losses	6,255	6,899	8,055	10,845	11,081	12,599	9,490	8,327	8,601	8,501	11,481	22,684
Venting	892	749	762	986	3,760	4,363	8,364	9,526	14,009	11,637	14,948	30,716
Total CH_4	8,436	8,943	10,179	13,468	16,944	19,065	22,465	23,663	25,261.80	22,537.97	28,787.37	55,226.01
CH_4 (As CO_2E)	177	188	214	283	356	400	472	497	530	473	605	1,160
N_2O Emissions (t/yr)												
Combustion	12.05	13.20	14.48	17.33	26.44	26.40	45.07	56.42	49.06	46.64	48.87	40.09
Electric Power Consumption	1.38	2.01	2.29	2.91	6.34	7.54	11.64	24.88	25.72	26.46	31.18	41.58
Fugitive Leaks and Other Losses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total N_2O	13.43	15.21	16.77	20.24	32.78	33.94	56.71	81.31	74.78	73.10	80.05	81.67
N_2O (As CO_2E)	4.16	4.72	5.20	6.27	10.16	10.52	17.58	25.20	23.18	22.66	24.81	25.32
CO_2E Emissions (t/yr)												
Combustion	279,208	277,940	300,123	363,144	554,817	553,376	699,865	817,950	797,626	739,510	815,322	1,087,746

Table 3-2: Summary of GHG emissions presented by pollutant and type of emission source

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Electric Power Consumption	104,761	119,345	120,317	149,758	171,717	193,812	341,033	555,548	581,067	604,001	745,596	894,847
Fugitive Leaks and Other Losses	131,708	145,256	169,552	228,268	233,337	265,319	199,921	175,494	181,042	179,005	241,733	478,412
Formation CO_2	41,624	49,233	43,703	36,556	44,469	47,812	30,025	86,593	87,080	69,168	60,109	113,542
Venting	18,753	15,749	16,007	20,721	79,018	105,715	216,673	200,653	295,370	245,482	314,877	646,392
Total CO_2E	576.054	607.523	649.702	798.447	1,083.358	1,166.034	1,487.517	1,836.238	1,942.184	1,837.166	2,177.637	3,220.939

1. In 2001 and 2002 raw CO_2 venting from the Wildboy gas processing plant were reported as vent gas. In 2003 and 2004 these volumes are reported as Formation CO_2. Formation CO_2 represents carbon dioxide produced directly from reservoirs (Wildboy and Minnehik-Buck Lake Gas Plants contribute the majority of Formation CO_2).
2. CH_4 emissions change dramatically in 2000 due to updated emission factors.

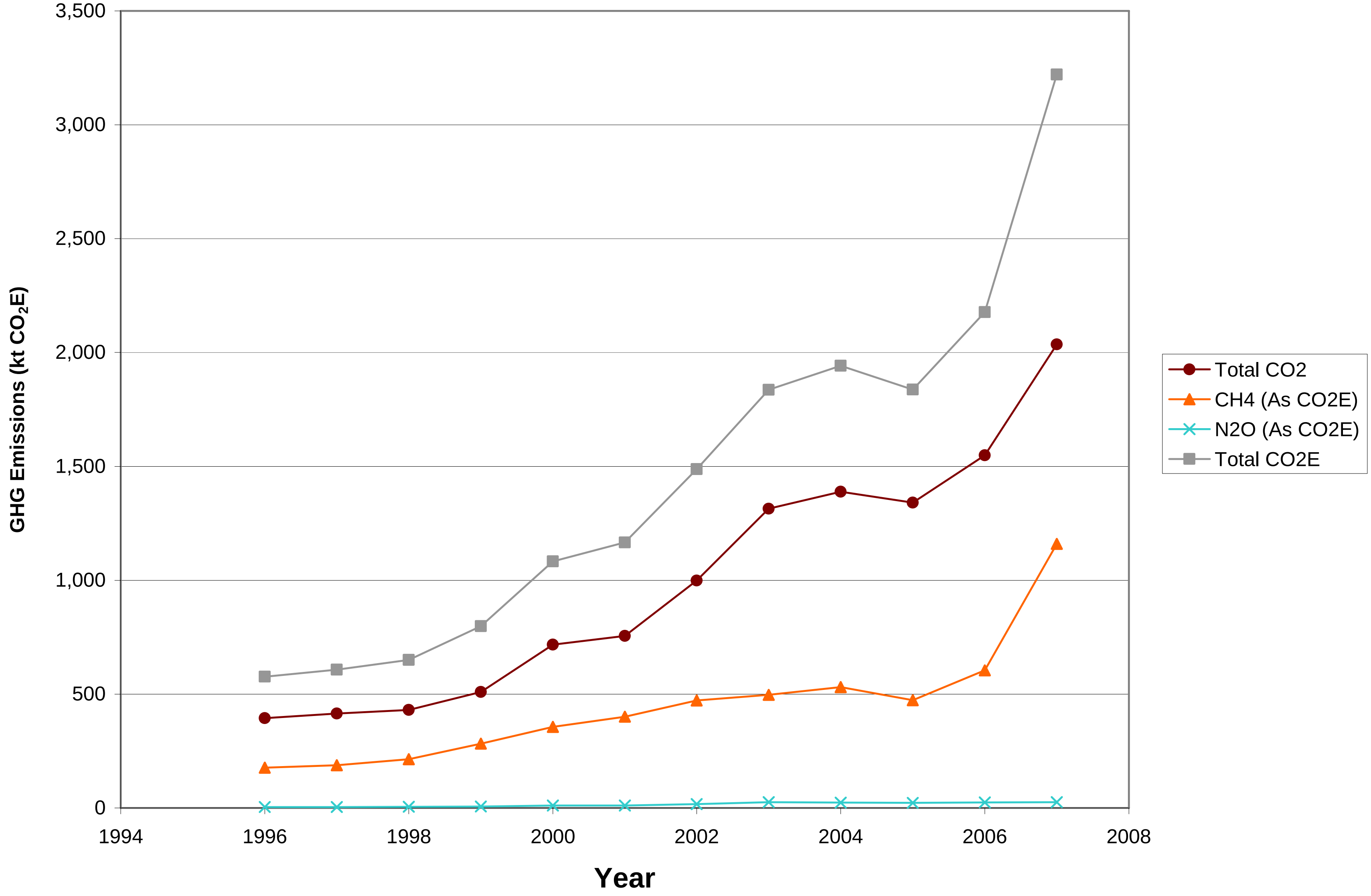
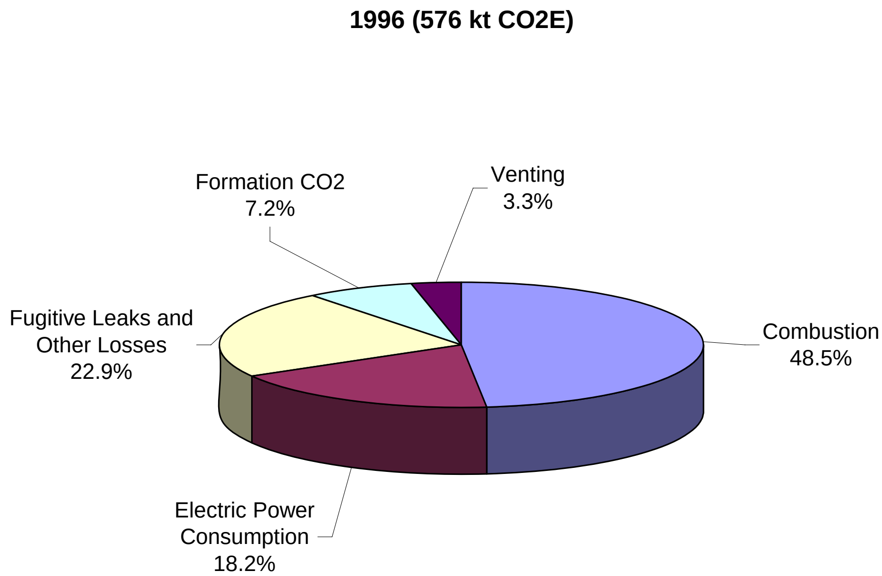


Figure 3.2 GHG Emissions by Type of GHG (Before Offsets)



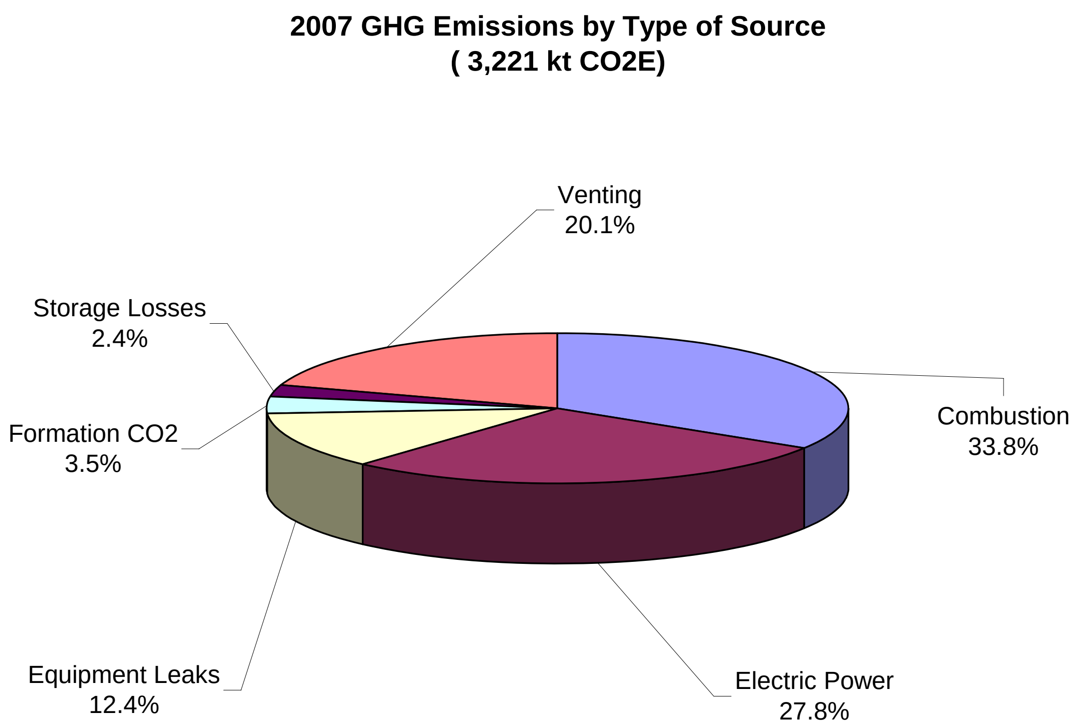


Figure 3.3 Comparison of GHG Emissions by Type of Source

4 Greenhouse Gas Emission Reduction Activities

4.1 Analysis of Emission Reduction Activities

CO_2 Enhanced Oil Recovery projects have continued to be a successful part of Penn West's GHG emission reduction strategy. Penn West has ownership interest in four CO_2 sequestration projects resulting in 2007 GHG reductions equal to 509,810 t CO_2E (Table 4.1).

Table 4-1:Total CO_2 Sequestration (t CO_2E) Claimed by PennWest

Year	Facility				Total
	Joffre	Pembina[1]	Weyburn[2]	Midale[2]	
2001	12,250	-	-	-	**12,250**
2002	47,022	-	-	-	**47,022**
2003	34,096	-	-	-	**34,096**
2004	43,214	-	-	-	**43,214**
2005	48,036	24,364	-	-	**72,400**
2006	31,048	34,525	194,232	326	**260,131**
2007	31,660	18,200	424,750	35,200	**509,810**

[1] Pembina CO_2 Injection commenced in March 2005

[2] 2006 Weyburn and Midale CO_2 Injection volumes are from July 1, 2006 - January 1, 2007

Other emission reduction efforts focus on energy efficiency and gas conservation as a cost effective means of reducing GHG emissions and other environmental impacts from our production activities.

The following sections provide a brief description of the GHG emission reduction projects undertaken by Penn West in 2007 and those proposed for 2008. Table 4.2 provides a brief outline of the projects implemented and the estimated emission reduction each production area achieved. Table 4.2 shows a total of 117 kt CO_2E of reductions were achieved in 2007 with a further 11.1 kt CO_2E projected in 2008.

Table 4.2 Emission Reduction Projects								
				Emission Reduction (t)				
Province	Year	Production Area	Project Description	Source	CO_2	CH_4	N_2O	CO_2E
AB	2007	10-32-051-08W5	Shut down compressor and switch to plunger lift	Fuel Gas:	78.5	0.2	0.0	84.6
				Fugitive:	0.0	1.1	0.0	23.2
				Net:	78.5	1.3	0.0	107.9
AB	2007	06-19-042-06W5	Install air compressor instead of using propane.	Fuel Gas:	0.2	0.5	0.0	19.4
				- Electric Power:	0.8	0.0	0.0	0.8
				Net:	-0.6	0.5	0.0	18.6
AB	2007	16-32-041-07W5	Shut down 2 compressors	Fuel Gas:	0.9	1.8	0.1	72.9
				Fugitive:	0.0	2.8	0.0	58.2
				Net:	0.9	4.6	0.1	131.1
AB	2007	14-06-043-06W5	Install air compressor for battery	Fuel Gas:	0.5	1.0	0.1	38.9
				Net:	0.5	1.0	0.1	38.9
AB	2007	09-22-042-07W5	Shut down 1 compressor	Fuel Gas:	0.5	1.0	0.1	38.9
				Fugitive:	0.0	2.8	0.0	58.2
				Net:	0.5	3.8	0.1	97.1
AB	2007	06-21-042-07W5	Shut down 1 compressor	Fuel Gas:	0.4	0.8	0.0	31.1
				Fugitive:	0.0	1.8	0.0	37.2
				Net:	0.4	2.6	0.0	68.3
AB	2007	08-36-020-16W4M	Changed out level controller water section of condensate stabilizer from Fisher 2900 to Fisher L2 level controller. Changed out plant inlet separator level controller from ce natco no model # to Fisher L2 level controller.	Vented Gas:	0.6	80.5	0.0	1,691.8
				Net:	0.6	80.5	0.0	1,691.8
AB	2007	14-17-052-08W5	Shut down compressor (Compressor was a 100 HP electric drive concept package)	Electric Power:	137.8	0.0	0.0	140.4
				Net:	137.8	0.0	0.0	140.4
AB	2007	04-29-052-08W5	Switch from propane to air compressor for instrument air	Propane:	0.0	0.0	0.0	0.0
				Net:	0.0	0.0	0.0	0.0
AB	2007	11-33-050-08W5	Switch to electric heater, as well as bringing in an electric chemical pump.	Fuel Gas:	0.0	0.0	0.0	0.2
				Vented Gas:	0.0	1.0	0.0	20.7
				Fugitive:	0.0	1.3	0.0	26.6
				- Electric Power:	0.0	0.0	0.0	0.0

Table 4.2 Emission Reduction Projects								
				Emission Reduction (t)				
Province	Year	Production Area	Project Description	Source	CO_2	CH_4	N_2O	CO_2E
				Net:	0.0	2.3	0.0	47.4
AB	2007	10-16	Switch from chemical pump to electric pump(1)	Net:	0.0	0.0	0.0	0.0
AB	2007	Rainer	Switch ArrowC66 pumpjack engines fuel from sour gas to propane(3)	Net:	0.0	0.0	0.0	0.0
AB	2007	03-19-065-10W5	Tie in project at AMOCO SWAN HILLS BATTERY #9	Vent:	315.8	2.3	0.0	6,634.0
				Net:	315.8	2.3	0.0	6,634.0
AB	2007	11-13-087-09W5	Tie in project at RED EARTH BTY #1	Vent:	236.4	1.7	0.0	4,966.5
				Net:	236.4	1.7	0.0	4,966.5
AB	2007	15-09-041-01W4	Tie in project at HAYTER 15-9-41-1W4	Flared Gas:	7.5	1,022.8	0.0	1,181.1
				Vent:	0.5	0.0	0.0	11.0
				Net:	8.0	1,022.8	0.0	1,192.1
AB	2007	02-36-067-10W5	Tie in project at SWAN HILLS 02-36-067-10W5	Vent:	144.5	1.1	0.0	3,036.4
				Net:	144.5	1.1	0.0	3,036.4
AB	2007	12-29-091-12W5	Tie in project at SAWN LAKE (HUSKY)	Flared Gas:	13.4	1,820.7	0.0	2,102.5
				Net:	13.4	1,820.7	0.0	2,102.5
AB	2007	11-32-087-12W5	Tie in project at OTTER 11-32-87-12W5	Flared Gas:	20.5	2,795.4	0.0	3,228.1
				Net:	20.5	2,795.4	0.0	3,228.1
AB	2007	12-17-087-08W5	Tie in project at RED EARTH BATTERY #1	Flared Gas:	3.7	500.7	0.0	578.3
				Vent:	178.4	1.3	0.0	3,747.3
				Net:	182.1	502.0	0.0	4,325.6
AB	2007	09-20-088-11W5	Tie in project at OTTER 9-20 & 11-29-88-11W5	Flared Gas:	1.6	223.5	0.0	258.0
				Net:	1.6	223.5	0.0	258.0
AB	2007	10-30-031-23W3	Tie in project at COLEVILLE 10-30-31-23 W3	Flared Gas:	4.6	625.7	0.0	722.5
				Net:	4.6	625.7	0.0	722.5
AB	2007	07-26-031-23W3	Tie in project at EUREKA (MAXIMUM N. EUREKA UNIT)	Flared Gas:	1.9	257.4	0.0	297.3
				Vent:	91.7	0.7	0.0	1,926.4
				Net:	93.6	258.1	0.0	2,223.7
AB	2007	13-16-27-26 W3	Tie in project at PENN WEST GLIDDEN	Flared Gas:	17.8	2,420.8	0.0	2,795.5
				Vent:	862.4	6.3	0.0	18,116.0
				Net:	880.1	2,427.1	0.0	20,911.5
AB	2007	10-30-072-04W5	Mitsue Acid Gas Injection instead of	Formation CO2:	199.9	0.0	0.0	199.9

Table 4.2 Emission Reduction Projects								
Province	Year	Production Area	Project Description	Emission Reduction (t)				
				Source	CO_2	CH_4	N_2O	CO_2E
			flaring (PennWest acquired this project in September 2007)	Net:	199.9	0.0	0.0	199.9
AB	2007	05-02-053-26W4	Acheson Acid Gas Injection instead of flaring	Formation CO2:	4,870.2	0.0	0.0	4,870.2
				Net:	4,870.2	0.0	0.0	4,870.2
All	2007	All	Electric motor Power Factor improvement program	Electric Power:	58,904.4	10.7	2.8	60,000.0
				Net:	58,904.4	10.7	2.8	60,000.0
			2007 SubTotal:		**66,094.0**	**9,787.5**	**3.2**	**117,012.6**
AB	2008	10-25-014-11 (North)	Update Burner system on treater. More efficient system. $107-$110 saving in fuel gas/day	Fuel Gas:	0.2	0.4	0.0	14.3
				Net:	0.2	0.4	0.0	14.3
AB	2008	10-25-014-11 (South)	Update Burner system on treater. More efficient system. $173-$180 saving in fuel gas/day	Fuel Gas:	0.3	0.6	0.0	23.3
				Net:	0.3	0.6	0.0	23.3
AB	2008	14-11-015-11	Remove genset and replace with electric utility	Fuel Gas:	0.1	0.1	0.0	4.3
				Fugitive:	0.0	0.7	0.0	15.0
				- Electric Power:	0.2	0.0	0.0	0.2
				Net:	-0.1	0.8	0.0	19.1
AB	2008	01-14-015-11	Remove genset and replace with electric utility	Fuel Gas:	0.1	0.1	0.0	4.3
				Fugitive:	0.0	0.7	0.0	15.0
				- Electric Power:	0.2	0.0	0.0	0.2
				Net:	-0.1	0.8	0.0	19.1
AB	2008	102/05-13-15-11	Remove genset and replace with electric utility	Fuel Gas:	0.1	0.1	0.0	4.3
				Fugitive:	0.0	0.7	0.0	15.0
				- Electric Power:	0.2	0.0	0.0	0.2
				Net:	-0.1	0.8	0.0	19.1
AB	2008	100/08-14-15-11	Remove genset and replace with electric utility	Fuel Gas:	0.1	0.1	0.0	4.3
				Fugitive:	0.0	0.7	0.0	15.0
				- Electric Power:	0.2	0.0	0.0	0.2
				Net:	-0.1	0.8	0.0	19.1
AB	2008	16-11-042-07W5	S/D compressco compressor no longer needed	Fuel Gas:	0.2	0.3	0.0	13.3
				Fugitive:	0.0	3.0	0.0	63.8
				Net:	0.2	3.4	0.0	77.1
AB	2008	3/14-18-042-06W5	Install smaller compressor	Fuel Gas:	0.0	0.1	0.0	3.3

Table 4.2 Emission Reduction Projects								
Province	Year	Production Area	Project Description	Emission Reduction (t)				
				Source	CO_2	CH_4	N_2O	CO_2E
				Net:	0.0	0.1	0.0	3.3
AB	2008	11-35-021-19	Switch instrumentation from fuel gas to air	Fuel Gas:	0.0	0.0	0.0	0.0
				Fugitive:	0.0	0.4	0.0	9.4
				Net:	0.0	0.5	0.0	9.5
AB	2008	02/08-20-015-11W4	Change well from single well battery to pipelined to main battery	Vented Gas:	0.0	0.0	0.0	0.4
				Net:	0.0	0.0	0.0	0.4
AB	2008	02/16-16-015-11W4	Change well from single well battery to pipelined to main battery	Vented Gas:	0.0	0.0	0.0	0.5
				Net:	0.0	0.0	0.0	0.5
AB	2008	03/10-21-015-11W4	Change well from single well battery to pipelined to main battery	Vented Gas:	0.0	0.0	0.0	0.7
				Net:	0.0	0.0	0.0	0.7
AB	2008	14-34-041-07W5	Use air compressor insteads of using fuel gas	Vented Gas:	0.1	12.0	0.0	253.1
				Net:	0.1	12.0	0.0	253.1
AB	2008	10-13-043-08W5	Tie solution gas from single well oil battery into on lease compressor to be processed at 14-01-042-07W5	Vented Gas:	0.3	35.6	0.0	748.8
				Net:	0.3	35.6	0.0	748.8
AB	2008	10-09-020-16	Repair leaks and venting from fugitive emission survey conducted by GreenPath Energy Ltd.	Vented Gas:	0.1	8.4	0.0	177.4
				Fugitive:	0.0	0.4	0.0	9.3
				Net:	0.1	8.9	0.0	186.7
AB	2008	08-36-020-16W4	Repairs from GHG emission survey conducted by GreenPath Energy Ltd.	Vented Gas:	0.2	30.8	0.0	647.3
				Fugitive:	0.0	0.4	0.0	9.4
				Net:	0.2	31.3	0.0	656.8
AB	2008	14-06-043-06W5	Use air to start 90 hp screw compressor instead of gas. Estimated at 0.021 dec/start and 3 starts/month	Vented Gas:	0.0	0.3	0.0	5.3
				- Vented Gas:	0.0	0.0	0.0	0.1
				Net:	0.0	0.2	0.0	5.2
AB	2008	15-09-041-01W4	Install VRU compressor to capture tank vapor gas and compress and send for sales.	Flared Gas:	244.6	1.8	0.0	282.5
				Net:	244.6	1.8	0.0	282.5
AB	2008	15-20-015-11W4	Change well from single battery to pipelined to main battery	Flared Gas:	0.5	0.0	0.0	0.6
				Net:	0.5	0.0	0.0	0.6
AB	2008	13-15-015-11W4	Take well off single well battery and put all gas and fluid down new pipeline to battery	Flared Gas:	0.0	0.0	0.0	0.2
				Vented Gas:	0.3	0.0	0.0	0.4
				Net:	0.3	0.0	0.0	0.6

Table 4.2 Emission Reduction Projects								
				Emission Reduction (t)				
Province	**Year**	**Production Area**	**Project Description**	**Source**	**CO_2**	**CH_4**	**N_2O**	**CO_2E**
SK	2008	Hoosier-Denzil	Install gas line connecting several locations to a header and flare system. A boost gas compressor was installed and gas was gathered and boosted to sale.	Flared Gas: Net:	3,447.5 3,447.5	25.3 25.3	0.0 0.0	3,981.2 3,981.2
AB	2008	102/10-33-016-12	Install air compressor at 10-33 satellite to replace the use of propane to run instrumentation[2]	Net:	0.0	0.0	0.0	0.0
AB	2008	100/05-13-015-11	Replace gas driver chemical pump with electric pump[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	102/16-20-16-12	Run electrical power to wellhead instead of using arrow motor[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	102/14-20-16-12	Run electrical power to wellhead instead of using arrow motor[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	102/12-28-16-12	Run electrical power to wellhead instead of using arrow motor[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	102/06-28-16-12	Run electrical power to wellhead instead of using arrow motor[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	102/14-33-16-12	Run electrical power to wellhead instead of using arrow motor[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	100/15-20-16-12	Run electrical power to wellhead instead of using arrow motor[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	11-35-51-13W5	Run electrical power to wellhead instead of using arrow motor[1]	Net:	0.0	0.0	0.0	0.0
AB	2008	10-30-072-04W5	Mitsue Acid Gas Injection instead of flaring	Formation CO2: Net:	561.1 561.1	0.0 0.0	0.0 0.0	561.1 561.1
AB	2008	05-02-053-26W4	Acheson Acid Gas Injection instead of flaring	Formation CO2: Net:	4,263.1 4,263.1	0.0 0.0	0.0 0.0	4,263.1 4,263.1
			2008 SubTotal:		**8,518.0**	**123.4**	**0.1**	**11,145.2**
			Total GHG Emission Reductions in 2007 and 2008:		**74,611.9**	**9,910.9**	**3.3**	**128,157.8**

[1] Direct GHG emissions have decreased by eliminating fuel consumption at the site. However, indirect GHG emissions have increased by adding electricity consumption resulting in a negligible net GHG reduction.

[2] Replacement of propane with air to power pneumatic instrumentation results in a reduction of Volatile Organic Compounds (VOC) but not GHG emissions.

[3] Fuel switching from sour gas to propane results in a decrease of SO_2 emissions but has little impact on GHG emissions.

4.2 Cumulative Emission Reductions

To illustrate the success of past GHG emission reduction projects, a comparison of actual annual GHG emissions to those for the business-as-usual case has been prepared (See Figure 4.1.). The business-as-usual case includes the actual annual GHG emissions plus any quantifiable emission reductions that occurred as a result of GHG emission reduction projects. In some cases the reported reductions are a one-time event (e.g., eliminating flaring of well test gases) while in others the reduction is assumed to occur over an extended period of years (e.g., acid gas re-injection).

Overall, as of the end of 2007, Penn West has reduced its operations GHG emissions by 665 kt, or more than 17 percent lower than the business-as-usual (BAU) case. BAU emissions projected to 2014 are presented by pollutant type in Table 5.2.

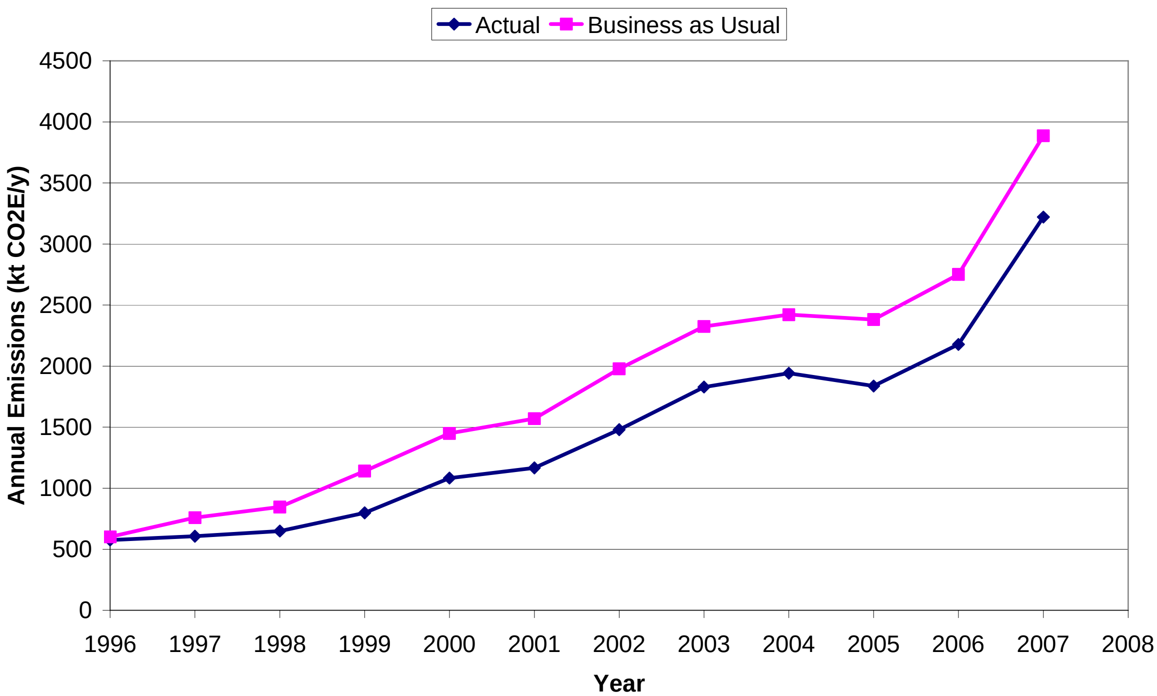


Figure 4.1 Comparison of Actual GHG Emissions to Business-as-usual Case

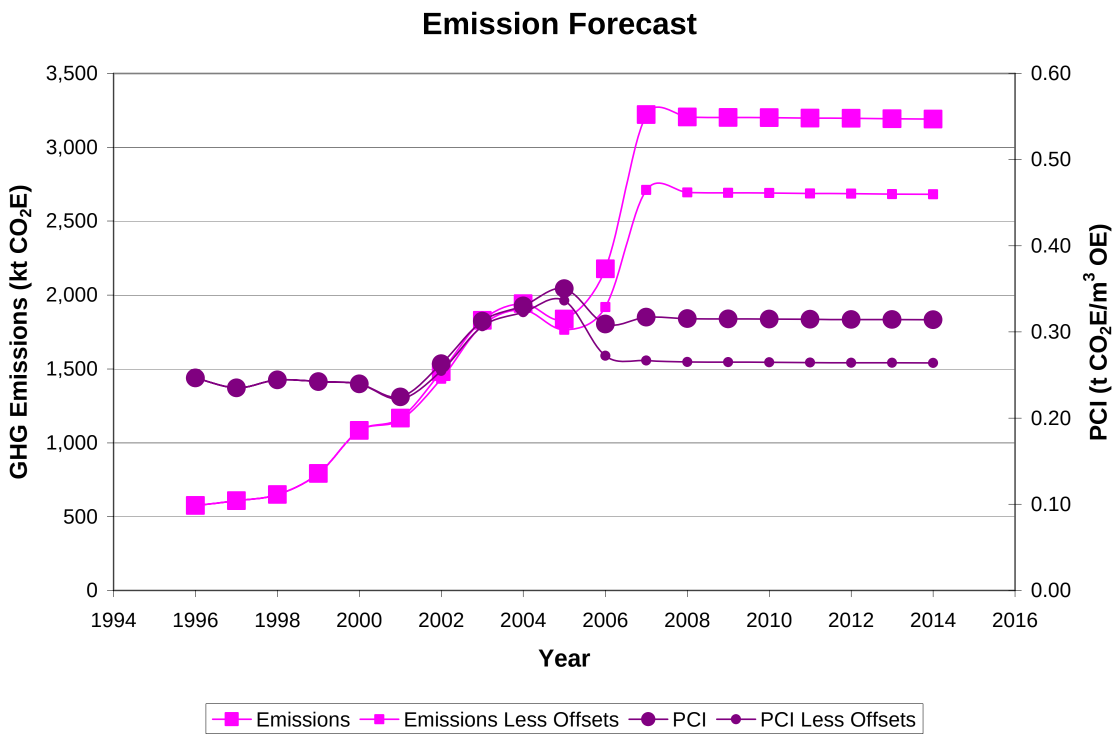
5 Forecasts

Penn West's past and projected production for the period from 1996 to 2014 is shown in Figure 5.1. Production increased almost tenfold in the period 1993 to 1997 before leveling off in 1998. With the acquisition of BP-Amoco's operations in the Central and Plains core areas of Alberta, production increased by about 40 percent in 1999 and 2000, and continued to increase at a similar rate through 2004. Penn West continues to increase it production through acquisition and in 2007 produces approximately $10{,}158 \times 10^3$ m^3 OE per year[3].

Figure 5.1 also presents the production carbon intensity (i.e., CO_2E emissions per unit of production [PCI]) and the energy intensity (i.e., energy consumption per unit of production [PEI]) for Penn West operations. GHG emissions for 2008 through 2014 have been estimated based on the following assumptions:

- In response to provincial flaring and venting regulations (e.g. Alberta ERCB Directive 60: Upstream Petroleum Industry Flaring, Incinerating, and Venting and the British Columbia OGC Flaring, Incinerating and Venting Reduction Guideline) , the overall volume of waste gas that is either flared or vented is expected to decrease at a rate of 2% per year from now through 2014.
- As heavy oil production volumes increase, a net increase in waste casing gas is also expected. Gas conservation projects are expected to recover the majority of this gas; therefore, vent volumes are expected to remain relatively constant through 2014.
- Energy consumption (i.e., fuel gas and electric power consumption) is expected to keep pace with production. Therefore, fuel gas volumes and electric power consumption are assumed to remain proportional to production rates through to 2014.
- The Pembina, Joffre, Weyburn and Midale CO_2 Injection Projects sequestered approximately 509.81 kt CO_2E in 2007. The projects are expected to sequester CO_2 at the same rate until 2014.

[3] This volume accounts for all production at Penn West operated facilities and does not consider ownership interest.



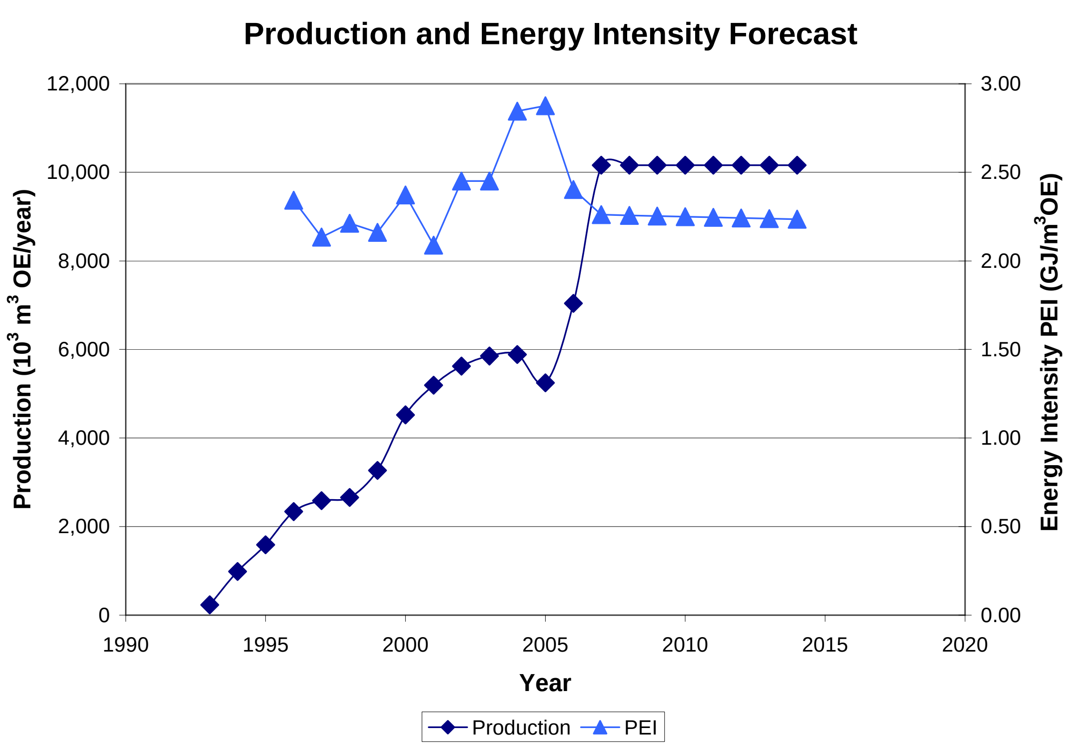


Figure 5.1 Emissions, Production and Energy Forecasts

A detailed breakdown of projected GHG emissions by type of source and type of pollutant is presented in Tables 5.1 and 5.2. Based on the assumptions above, absolute emissions of GHGs will remain relatively constant at 3,200 kt CO_2E/y by 2014, a 270 percent increase from the 1996 baseline. Energy consumption will increase to 16,700 TJ/y, a 550 percent increase, and production will remain approximately constant at the 2007 level of 10,200 10^3m^3 OE. In terms of relative quantities, energy consumption per unit production is expected to be about 2.24 GJ/m^3 OE by 2014 despite decreasing reservoir pressures and increasing water production. GHG emissions per unit production are also expected to remain essentially constant at 0.317 t CO_2E/m^3 OE and to 0.268 t CO_2E/m^3 OE when offsets are included.

Table 5-1: Present and Projected GHG Emissions Presented by Type of Source (kt CO_2E)

Source	2006	2007	2008	2009	2010	2011	2012	2013	2014
Combustion	815	1088	1071	1069	1067	1064	1062	1060	1058
Electric Power	746	895	895	895	895	895	895	895	895
Fugitive	242	478	478	478	478	478	478	478	478
Formation CO_2	60	114	114	114	114	114	114	114	114
Venting	315	646	646	646	646	646	646	646	646
Total	2178	3221	3204	3202	3200	3198	3195	3193	3191
Total Less Offsets	1918	2711	2695	2692	2690	2688	2686	2684	2681

Table 5-2: Present and Projected GHG Emissions Presented by Type of Pollutant (kt)

Pollutant	2006	2007	2008	2009	2010	2011	2012	2013	2014
CO_2	1,548	2,036	2,278	2,276	2,275	2,273	2,272	2,270	2,269
N_2O	0.080	0.082	0.118	0.118	0.118	0.117	0.117	0.117	0.117
CH_4	28.8	55.2	42.4	42.3	42.3	42.3	42.3	42.2	42.2
CO_2E	2,178	3,221	3,204	3,202	3,200	3,198	3,195	3,193	3,191
CO_2E Less Offsets	1,918	2,711	2,695	2,692	2,690	2,688	2,686	2,684	2,681

6 Emission Control Goal

Due to increasing production from Penn West operated facilities and acquisitions, an absolute emission control goal related to the 1996 baseline inventory is not achievable. Accordingly, Penn West set a GHG goal associated with an emission reduction per unit production instead of an absolute GHG emission reduction. This previously stated goal was to maintain GHG emissions per unit production (PCI) to the 1996 baseline level. However, due to acquisitions resulting in more energy intensive production techniques (i.e. secondary recovery methods) achieving the 1996 PCI level has become very difficult. Penn West may revisit its GHG goal in future years to reflect its asset portfolio.

7 Domestic Offsets and Joint Implementation

Penn West is currently involved in an innovative CO_2 injection and sequestration project in which CO_2 purchased from the NOVA Chemicals Joffre Ethylene Plant is injected into an oil producing formation as part of a miscible flood program. The purchased CO_2 is brought to reservoir pressure using electric compressors, and any CO_2 produced along with the oil is recycled and re-injected. We estimate that the Joffre Battery will continue to purchase and inject CO_2 for the next seven years. These offsets are incorporated in our emission forecast outlined in Section 5.

Based on the success of the Joffre CO_2 Injection Project, both as part of an enhanced oil recovery program and as a means to sequester CO_2, Penn West has commenced operation of CO_2 miscible floods in the Weyburn, Pembina and Midale areas.

8 Future Reporting

Penn West will continue to publish annual progress reports on its website. The reports will contain an inventory of GHG emissions for the previous year, an indication of the net change from the previous year, as well as information on current GHG emission mitigation measures and plans for future GHG emission reduction projects.

9 References

CAPP (Canadian Association of Petroleum Producers), July 1999. *CH_4 and VOC Emissions from the Canadian Upstream Oil and Gas Industry. Volume 2: Development of the Upstream Emissions Inventory*. Publication No. 1999-0010. Clearstone Engineering Ltd. Calgary, AB.

CAPP, April 2003. *Calculating Greenhouse Gas Emissions*. Publication No. 2003-0003. Altus Environmental Engineering Ltd. Calgary, AB.

CAPP, September 2004. *A National Inventory of Greenhouse Gas (GHG) Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H_2S) Emissions by the Upstream Oil and Gas Industry. Volumes 1 to 5* Clearstone Engineering Ltd. Calgary, AB.

Canadian Standards Association (CSA). 2005 Canadian GHG Challenge Registry: Guide to Entity & Facility Based Reporting, Version 4.3. Ottawa, ON.

Intergovernmental Panel on Climate Change, May, 2000. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Geneva, Switzerland.

ISO (International Standards Organization). 2006. Greenhouse Gases – Part 1: Specification with Guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals. CAN/CSA-ISO 14064-1:06. Available from the Canadian Standards Association.

Natural Resources Canada, 2005. 2004 Commercial and Institutional Consumption of Energy Survey. Ottawa, ON.

U.S. Environmental Protection Agency, 1995. *Compilation of Air Pollutant Emission Factors*, Volume I: Stationary Point and Area Sources. AP-42 5th edition and supplements. Research Triangle Park, NC.

10 Glossary

Anthropogenic – Man made. This includes all greenhouse gas emissions that result from human activity (e.g., consumption of fossil fuels, venting of methane and other greenhouse gases, land use changes [resulting in altering uptake of CO_2], etc.).

API Gravity - The universally accepted scale adopted by the American Petroleum Institute (API) for expressing the density of liquid petroleum products. The higher the API gravity, the lighter the oil.

Business As Usual (BAU) - The normal course of activities, and estimated GHG emission levels, that would occur without any emission reduction initiatives implemented.

Carbon Dioxide Equivalent (CO_2E) – Total emissions of all greenhouse gases. Each greenhouse gas is converted to its carbon dioxide equivalent by multiplying by the appropriate global warming potential.

Fugitive Equipment Leaks – Unintended leakage from individual equipment components to the atmosphere. This emission category includes leakage from: flanged and threaded connections, valve packing systems, compressor seals, pressure relief valves, open-ended lines, etc.

Gas-oil Ratio (GOR) – Indicates the amount of natural gas produced from an oil well along with crude oil.

Global Warming Potential (GWP) – A simple measure of the global warming effects of the emissions of various greenhouse gases relative to those of carbon dioxide. The current practice is to use a 100-year time horizon for GWP. Therefore, the GWPs used in this document are: CO_2 = 1.0, CH_4 = 21.0, and N_2O = 310.0.

Greenhouse Gases (GHG) – A group of compounds in the atmosphere that tend to absorb solar radiation and reradiate it back to the earth's surface. The most important of these are: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

Indirect GHG Emissions – Greenhouse gas emissions associated with consumption of electrical power that is generated at fossil-fuelled thermal generating stations. Industry practice is for each company to account for their share of GHG emissions associated with power generation by the utilities.

Oil Equivalent (OE) – Hydrocarbon production volumes converted to an equivalent volume of medium crude oil using the energy content. The Alberta ERCB has adopted the following energy content factors: natural gas – 37.4

MJ/m^3, medium crude oil – 38.5 GJ/m^3, heavy crude oil – 41.4 GJ/m^3, crude bitumen – 42.8 GJ/m^3 and pentanes plus – 33.1 GJ/m^3.

Production Carbon Intensity (PCI) – A measure of the amount of the CO_2E emissions a company emits per cubic metre of oil equivalent produced. The units are tonnes of carbon dioxide equivalent per cubic metre of oil equivalent production (t CO_2E/m^3 OE).

Production Energy Intensity (PEI) – A measure of the amount of energy required per cubic metre of oil equivalent production. The numerator is the sum of all energy consumed by the company, in GJ, (i.e., fuel gas consumed, volume of waste gas flared or vented, electric power consumption, propane consumed, etc.) and the denominator is the total volume of production in cubic metres of oil equivalent. The units are gigajoules (i.e., 10^9 joules) per cubic metre of oil equivalent production (GJ/m^3 OE).

Uncertainty in Emission Estimate – A bottom-up method in which the uncertainty in the emission estimates for individual sources is estimated based on the uncertainty in the applied emission factor and activity data. The more narrow the range of uncertainty, the more reliable the estimate.