# Engineering and Economic Analysis of Natural Gas Production in the Norton Basin


Prepared as a project for:

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Cover:

Top – Santa Fe Key Hawaii drilling rig (drilled well Y-0436).

Center – Nome, Alaska.

Bottom – Unknown Arctic drilling rig.

# Abstract

The Engineering and Economic Analysis of Natural Gas Production in the Norton Basin summarizes the potential of developing natural gas from the Norton Basin on a local level using engineering and geology within a spreadsheet model. The engineering and geology figures are finalized within an economic summary of the whole project. The model analyzes numerous aspects of production from Norton Sound beginning with the physical parameters of the gas resource inside a formation and proceeds all the way to the utilization of gas at the distribution center. The model firsts looks at local conditions and variables such as existing demand, future growth, existing infrastructure and seasonal production differences. It then examines large scale capital costs, engineering, and geology. Economic factors such as oil and gas prices, state and federal tax rates, infrastructure costs, production costs, government royalties, and government subsidies are then thoroughly analyzed. In the end, final economic figures are produced. The analysis portrays one possible production scenario with several economic alternatives. The procedure shown in this analysis indicates that this would be marginally economic, but the alternatives offer a range of options that would make the costs of producing gas in the Norton Sound more attractive.

# Acronyms, Abbreviations, and Symbols

| | |
|---|---|
| ANS | Alaska North Slope |
| AOF | Absolute Open-hole Flow |
| API | American Petroleum Institute |
| Bcf | Billion Cubic Feet |
| BTU | British Thermal Unit |
| $CO_2$ | Carbon Dioxide |
| COST | Continental Offshore Stratigraphic Test (COST Well) |
| CPI | Consumer Price Index |
| DCF | Discounted Cash Flow |
| DNR | Department of Natural Resources (AK) |
| DOE | U.S. Department of Energy |
| DOR | Department of Revenue (AK) |
| EIA | Energy Information Administration (DOE) |
| EOR | Enhanced Oil Recovery |
| EPA | Environment Protection Agency |
| ERW | Extended Reach Well |
| FEIS | Final Environmental Impact Statement |
| Gal | Gallon |
| IDC | Intangible Drilling Cost |
| IPR | Inflow Performance Curve |
| IRS | Internal Revenue Service |
| KWh | Kilowatt-hour |
| LNG | Liquefied Natural Gas |
| MACRS | Modified Accelerated Cost Recovery Schedule |
| Mcf | Thousand Cubic Feet |
| MMS | Minerals Management Service |
| Mscf | Thousand Standard Cubic Feet |
| MTWSF | Mid-Tertiary West Sub-basin Fill play |
| NGL | Natural Gas Liquid |
| NPV | Net Present Value |
| OCS | Outer Continental Shelf |
| P/I | Profit/Investment Ratio |
| PCE | Power Cost Equalization (State of AK) |
| $R^2$ | Coefficient of Determination |
| ROI | Return on Investment |
| TAPS | Trans-Alaska Pipeline System |
| USGS | U.S. Geological Survey |
| WACC | Weighted Average Cost of Capital |
| Yr | Year |

# Executive Summary

According to the estimates in the Undiscovered Oil and Gas Resources, Alaska Offshore 1995 Assessment, the Norton Basin contains 2,707.80 BCF of potential undiscovered natural gas. Of this amount, at least 29.44 BCF is producible over 30 years and is located within 30 miles of Nome. This large potential natural gas resource has not been explored yet. The rise of gas prices in the last few years, the introduction of energy incentives, and the advent of new technologies, have changed the prospectiveness of a small-scale, local consumption natural gas production project in the Norton Basin. Commercial developments involving a large scale liquefied natural gas (LNG) exportation gas development project would not be economic.

Using well managed pressure/volume/temperature engineering, efficient well planning, and advanced exploration, drilling and production methods, peak flow rates of 6.15 MMscf/d and averages of 2.42 MMscf/d are realistically attainable from a small two well stand-alone production facility 40 miles offshore from Nome (with one additional cuttings and $CO_2$ injection well). The gas market for the Norton Basin gas analysis is the Norton Sound area and the federal share would utilize a 12.50% royalty rate, but this rate would likely be suspended or reduced. Because this is a feasibility study with an assumption of discovered gas, the geological chance of success is set at 100%.

The Net Present Value (NPV) for the Norton Sound gas study is $16.36 million based on an after tax discounted cash flow analysis when evaluated using $18.65/Mcf (2004$, on a KWh basis) gas price starting in year 2005, and a linear regression hydrocarbon forecasting analysis. If the Energy Information Administration's 2001 reference oil and gas forecast is used, the NPV value increases greatly because of expected price growth assumptions. Utilization of advanced new technologies such as subsea production facilities and $CO_2$ sequestration systems assist in lowering cost and increasing the estimated NPV value, to a level that would not have been possible before.

Subsidized financing from the State of Alaska and the Federal Government would further enhance the economics of this study. For example, if the Federal Government provided a lease free of bonus and royalty for the pool, the NPV would be more attractive. The Environmental Protection Agency has expressed the likelihood of incentives to investors for reducing $CO_2$ and diesel byproduct emissions, which would also influence NPV.

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# A. INTRODUCTION: ENGINEERING ANALYSIS OF THE NORTON BASIN

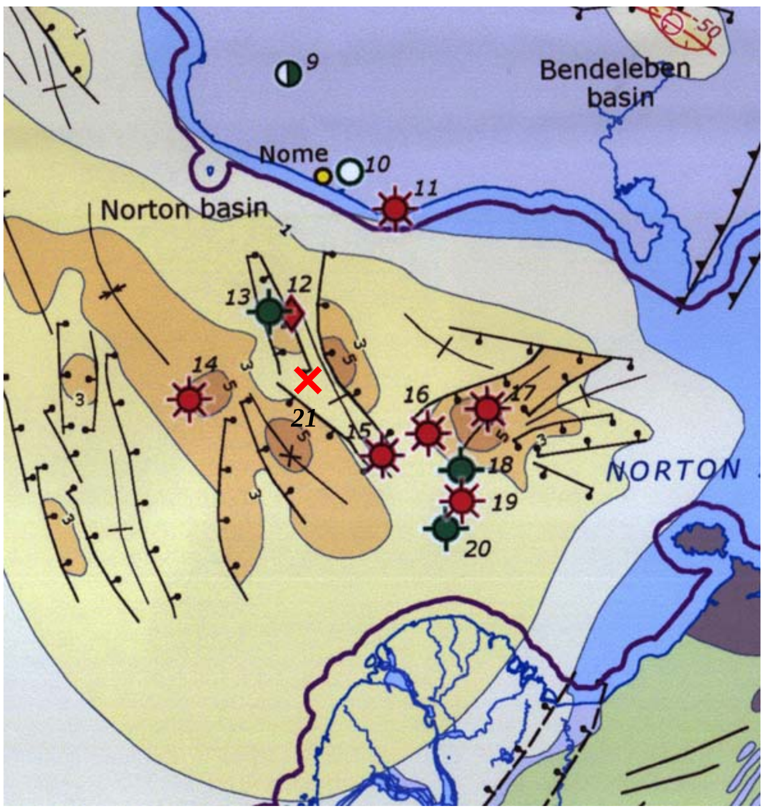
One of the aspirations of any city in the world is affordable energy, simply because energy has a strong correlation with economic prosperity. Unfortunately, as the distance between the energy source and market increases, this goal becomes less attainable. The objective of the proposed Engineering and Economic Analysis of Natural Gas Production in the Norton Basin study is to develop an engineering and economic model to help identify a bridge across the energy price gap for consumers and industry in the Norton Sound area. This, in-turn, will enhance independence, and provide industry and investors an economic feasibility study that demonstrates financial benefits for the owner and provides an affordable energy source for the rural Norton Sound area. The affordable energy could lead to an influx of new industries which could spark local economies and enhance the standard of living. More specifically the purpose of this engineering and economic analysis is to determine what proportion of the undiscovered conventionally recoverable hydrocarbon resources in Alaska's Norton Basin Outer Continental Shelf (OCS) Planning Area could be commercial in the Norton Sound market under optimistic engineering and economic conditions.

The Engineering and Economic Analysis of Natural Gas Production in the Norton Basin is strictly an engineering and economic study which builds upon existing geological data to answer the question, "if there is gas, can it produce and can it be economic." Gas is known to be in structures below the Norton Sound, but quantities are unknown. In fact, to date, no company has ever drilled for natural gas in the Norton Sound Basin.

### *Past Exploration Efforts*

The Norton Sound Basin has seen several periods of oil and gas exploration in the past, but has not yielded any reported gas pools in part due to lack of serious interest in gas production at the time. ARCO Alaska, Inc. drilled two Continental Offshore Stratigraphic Test (COST) wells in the Norton Basin. COST Well No. 1 (14) is located 54 miles southwest of Nome and was completed in September 1980. COST Well No. 2 (18) is located 68 miles southeast of Nome and was completed August 1982. COST Well No. 1's (14) mud logs indicated strong shows of methane at depths of 3,000 – 6,000 ft. COST Well No. 2's (18) showed only minor shows of gas.

**Figure 1. Location**




Source: Troutman and Stanley (2002)

The first, and only, Federal offshore lease sale in the Norton Basin, Sale 57, was held on March 15, 1983. The area offered consisted of 963,072 hectares (approximately 2.4 million acres). Of the 418 blocks offered, 64 tracts received 98 bids, with high bids totaling $325 million. Five bids were rejected, resulting in 59 leases (135,936 hectares) issued for a total bonus of $317,873,372. These leases were issued for an initial 10-year lease term with an effective date of June 1, 1983. (U.S. Dept. of the Interior, Bureau of Land Management, 1982).

After the sale, during the summer of 1984, Exxon Corporation drilled exploratory wells OCS Y-0414 (15), Y-0430 (19) and ARCO drilled exploratory well OCS Y-0436 (13). Exxon's OCS Y-0414 (15) and ARCO's OCS Y-0436 (13) wells showed strong shows of methane in the 1,200 – 3,600 ft. interval. These wells were later plugged and abandoned. Exxon then drilled exploration wells OCS Y-0407 (16), OCS Y-0398 (17), and OCS Y-0425 (19) in the Norton Basin in 1985. Wells OCS Y-0407 (16) and OCS Y-0425 (19) showed moderate to strong gas shows in the 1,000 ft. – 3,000 ft. interval. All three were also plugged and abandoned. Exploration targets at the time were for oil and the assumption was that commercial gas development would require a large scale LNG project designed for exportation which was currently uneconomic.

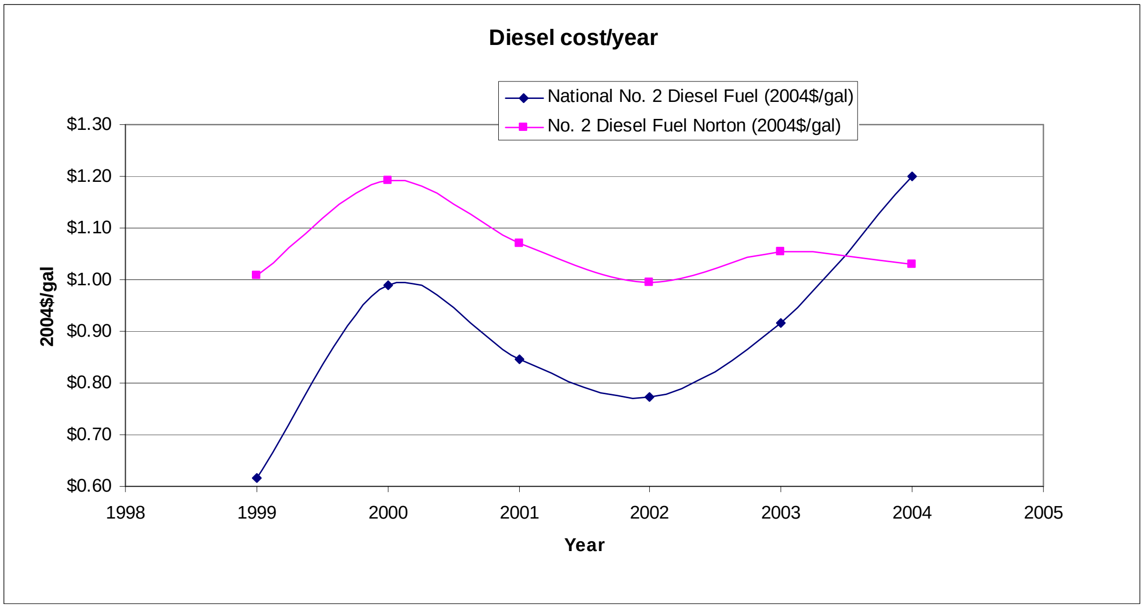
On December 18, 1985, the Norton Basin Sale 100 Final Environmental Impact Statement (FEIS) was released to the public for review. The proposed action analyzed in the FEIS would offer an area of 3,962,715 hectares offered for the lease sale. (U.S. Dept. of the Interior, Minerals Management Service, 1985). On April 11, 1986, the lease sale was canceled due to lack of industry interest.

There has not been a Norton Basin FEIS since Sale 100 and industry has yet to respond to calls for interest in the Norton Basin since lease Sale 57.

### *Natural Gas Marketability*

A great deal of uncertainty exists regarding the marketability of potential natural gas resources. The natural gas resources of the Norton Basin are potentially economic under an optimum location; that is, most of the gas must be located in a few large reservoirs at modest depths and near landfalls in order to be potentially economic. Currently, neither transportation systems nor non-local markets exist for Arctic or Bering Sea natural gas (large quantities of natural gas produced from the Prudhoe Bay oil field are being re-injected). Liquefied Natural Gas (LNG) would be transported in tankers, but LNG liquefaction, transportation (≈ $5.00/Mcf), and re-gasification facilities are very costly. (Sherwood, 2001, pp. 53). In addition, future markets and prices are uncertain, while natural gas from other areas and other hydrocarbons (oil and coal) are economically competed fuels. Presently, the local energy market in the Norton Sound area is primarily 135,000 BTU/gal No. 2 diesel fired electrical generation. The area consumes 1.8 million gallons of No. 2 diesel per year. (Handeland, 2003). This volume equates to 28.44 GWh/yr on a KWh basis or 97 MMscf/yr of equivalent natural gas. (See appendix 1, cells H49 and H51). This is where the Norton Sound natural gas energy illustrates potentially positive economic value. Since the primary source of Norton Sound energy consists of expensive, volatile shipments of diesel (see figure 2), there is plenty of potential for economic utilization of Norton Sound natural gas.

**Figure 2. Diesel Cost/year**




Source: U.S. Dept. of Energy, Energy Information Agency (2001)

## B. DEFINITIONS & ASSUMPTIONS FOR THE ENGINEERING & ECONOMIC MODEL

The definitions and assumptions for any study can make or break a project; therefore, descriptive definitions and proper assumptions are a strong part of this evaluation. The engineering analysis for this study was performed using Palisade's DecisionTools Suite version 4.5, Microsoft's Excel XP and Hewlett Packard's Pressure-Volume-Temperature application macro. A field attribute spreadsheet was designed using Norton Basin geologic input parameters listed in the U.S. Department of the Interior's Undiscovered Oil and Gas Resources, Alaska Federal Offshore 1995 Assessment. (U.S. Dept. of the Interior, MMS, Alaska OCS Region, 1998). The main purpose of the spreadsheets are to determine ideal production tubing sizes, producible flow rates, annual gas production, cumulative gas production, and final cost figures.

### *Area Location*

The Engineering and Economic Analysis of Natural Gas Production in the Norton Basin study is located 30-40 miles directly south of Nome, Alaska (64° 30' N 165° 26' W) in 50 feet of water and consists of one prospect. (See 21 on figure 1). The prospect lies in the Mid-Tertiary West Sub-basin Fill play (MTWSF) and covers a 12,400 acre area. (U.S. Dept. of the Interior, MMS, Alaska OCS Region, 1998).

### *Number of Wells*

The study analyzes the project using a minimum number of two production wells. In addition, both wells will produce from one formation. The reason for this is to allow continuous production if one well shuts down for maintenance or well damage. In addition, the flow rates and volumes producing from both wells will physically constitute further production. Multiple well analyzations from multiple formations were analyzed, but all alternatives started with, at least, two wells.

### *Geological Inputs*

The engineering design for the Nome prospect was derived from geological data found in the 1995 Undiscovered Oil and Gas Resources Assessment, Alaska Federal Offshore. From the geological data, it was calculated that the ideal pressures (producible pressures) in the Norton Sound area will be found in prospects which lie 3,000 feet or more below the sea floor. Due to pressure and location constraints only the Mid-Tertiary West Sub-basin Fill play (MTWSF) contains prospects extending deeper than the 3,000 foot required depth.

- The MTWSF play has an average depth of 5,500 feet below the sea floor. Other attributes include: specific gravity, 0.66; gas molar weight, 16; carbon dioxide, 10%; nitrogen, 0%; hydrogen sulfide, 0%; well radius, 0.3 ft.; abandonment pressure, 300 psi; average net pay thickness, 178 feet; porosity, 14%; formation temperature, 591°R; formation pressure, 2,475 psi; permeability, 0.900 md; and a gas recovery factor of 0.396 MMcf/acre-ft. (See appendix 10). (U.S. Dept. of the Interior, MMS, Alaska OCS Region, 1998).

Based on the given geological data, location of the project, and the location of market the wells drilled in the Engineering and Economic Analysis of Natural Gas Production in the Norton Basin study would adequately supply the Norton Sound area.

***Additional Inputs***

Gas specifics, standard conditions, study definitions, well specifics, etc. and other data were acquired from well logs, core logs, well summaries, and the application of industry standards. Additional data came from the Norton Basin Sale 57 and Sale 100 FEIS's. (U.S. Dept. of the Interior, BLM, 1982; U.S. Dept. of the Interior, MMS, 1985).

***Assumptions***

In order to properly assess the most economically stable project, the assumptions made included:

1. The market will be electrical generation for the Norton Sound area (ex. City of Nome, commercial mining, outlying villages, etc.)
2. The results of the economic analysis are reported as unrisked and risked values; unrisked implies that there is no geological risk and risk implies that a

specific risk factor was applied to the estimated resources and values. For the purpose of the Norton Basin feasibility study, the geologic probability of a gas discovery is assumed to be 100%; therefore, unrisked and risked values are equal. This analysis begins at the point of a significant gas discovery in the Norton Sound.

3. A 12.50% royalty rate will be paid to the Federal Government.
4. Only gas will be produced from production wells.
5. All wells will be as near as possible to Nome (the largest consumer in the area) for logistical and economic reasons.
6. Two production wells from the basin will be drilled. They will be the closest Outer Continental Shelf (OCS, Federal subsea land) wells to Nome that are still economically producible. The number of wells chosen was based on the given known geologic numbers and the demand for the area.
7. One disposal well will be used to dispose of drill cuttings and $CO_2$ as prescribed by the Environmental Protection Agency's (EPA) pollutant discharge permit under the Clean Water Act and by Alaska's Department of Environmental Conservation Solid Waste Treatment Permit.
8. A 20% skin factor[1] is appropriate for the reservoirs (see "Flow Calculations" in next section).
9. Abandonment pressures are at the point that the individual well is expected to kill itself (when well differential pressure is equal to 0; see "Flow Calculations" in next section).

[1] The skin factor term represents a pressure drop which most commonly arises due to formation damage around the wellbore. The damage is caused by the invasion of solids from the drilling mud. The solid particles partially block the pore space and cause a resistance to flow, giving rise to an undesirable pressure drop near the wellbore.

10. Economic life is estimated to be 30 years, even though actual well potential is estimated to be much greater. Any needed natural gas beyond the life of these wells must be explored and developed prior to the end of production of Norton Basin project.
11. Existing infrastructure and innovations will be utilized to keep costs to a minimum.
12. The economic energy comparison does not take into account the diesel Power Cost Equalization (PCE) consumer subsidy. This amount will be applied to Norton Sound energy costs as a credit to the consumers' utility bill no matter what source of energy is utilized by the Nome Joint Utility System.
13. A large natural gas storage facility is not needed for this analysis. It is assumed that there will be constant natural gas pressure all the way to the consumer's burner tip. This is synonymous to the Cook Inlet Basin supplying Anchorage, Alaska consumers.
14. A platform in the area will be used to drill the wells. A platform will not be commissioned from any location south of Bering Sea and outside of Alaska for economic reasons.

### *Flow Calculations*

Production rates and volumes are initially determined on an absolute open-hole flow basis (unchoked). This is a theoretical unrestricted calculation and is combined with friction calculations to determine realistic flow calculations. Friction indicators such as skin factor and flow characteristics are included in these calculations to determine instantaneous flow. This data is compared with inflow performance curves (IPR) to estimate annual production volumes and rates. (Energy Resources Conservation Board, 1975 and Jahn, 2000). (See appendices 1, 3, 11-18).

1. ***Absolute Open-Hole Flow Calculations*** – The main summary sheets (see appendices 12-18) summarize the characteristics of the Norton Basin wells on an absolute open-hole flow (AOF) basis. All flow and volume calculations begin with the AOF calculations and then further calculations are determined according to various specifics. Initial in-place pool size is the absolute maximum pool size of the given reservoir. The initial recoverable free gas is the amount of gas that is recoverable under the reservoir conditions. The final recoverable free gas is the total amount of gas that is recoverable at standard surface conditions. The average flow rate, production time to abandonment, and peak flow rate are also summarized at surface conditions. (Energy Resources Conservation Board, 1975, pp. 3-42 to 43). (See appendix 12).

2. ***Friction*** – One critical factor in the performance of any well is the amount of friction in a well bore. Friction effects become extremely significant the deeper a formation is. As fluid flow increases beyond their critical flow[2] point, stable characteristics begin to vanish. Therefore, the very instant that a formation becomes an open system (instantaneous flow) is the point at which flow instability is at its extreme. This deviation from unstable flow at surface conditions and stable flow at formation conditions can greatly vary well flow

[2] The Reynolds value at which flow changes between laminar and turbulent flow. This critical value was taken as $N_R = 2,000$.

performance. If the deviation is too extreme, then the well flow can be terminated by natural forces. Friction factor can determine whether a well will flow. (Daugherty and Franzini, 1977, pp. 192-193). (See appendix 13).

3. ***Feasible Flow & Production*** – The inflow performance curves (IPR) for the Norton Sound Basin were developed using different well tubing sizes that were compared with well flow over time to determine final frictional flows. The maximum flow rate with the largest pressure differentiation range is determined to be the most economical flow. The performance curves were compared with the estimated absolute open-hole flow of the Norton Basin wells to differentiate physical maximum flow with theoretical maximum flow. Flow and production were determined under flowing pressures over time and compared to IPR curves to determine physically possible flow rates and cumulative productions through the most optimum tubing. All curves were then interpolated to calculate annual Norton Sound production volumes and rates. The estimated annual production volumes and rates were then linked to economic regimes. A peak flow rate of 6.15 MMscf/d and an average of 2.42 MMscf/d were calculated to produce the 18.20 BCF producible reserves over 30 years through 3.00" ID tubing in MTWSF. (Energy Resources Conservation Board, 1975, pp. 3-34 to 3-37; Bradley, H. B. et. al., 1992, pp. 33-1 to 33-22, 35-1 to 35-14). (See appendix 11 cells L45, L43 and appendices 12-18).

## C. BASIC EXPLORATION, PRODUCTION, & TRANSPORTATION ASSUMPTIONS FOR EFFECTS ASSESSMENT

Gas production at sea poses a few obvious problems. Drilling crews have to operate through the depth of the sea water column. In addition, drilling crews in the Arctic have to deal with hostile climates, inhospitable to man and corrosive to machines. To deal with these specialized problems, oil field service contractors have fashioned new tools and techniques. These are employed once suitably promising locations have been identified by geophysical methods. Operating companies will then design their exploration drilling program, selecting among several choices of rigs depending on conditions. If the drilling is successful, production companies will then determine the most efficient pipeline routes to get the product to market.

### *Exploration, Delineation, & Development*

Jack-up drilling units have been considered as the primary units for drilling the exploration wells in the Norton Basin. A jack-up unit is a barge with legs that can be lowered or raised. The barge is towed to the drilling location with its legs in the raised position. Once in position, the legs are lowered. When they reach the seabed, the barge's body is hoisted above the water, creating a stable drilling platform.

Jack-ups have already been used to drill two Continental Offshore Stratigraphic Test (COST) wells in the Norton Basin, during the summers of 1980 and 1982. Jack-ups can only operate in the northeastern Bering Sea for a relatively short period of the year because of the sea-ice conditions.

To maintain a minimal project cost, the same jack-up drilling unit used for exploration will be used to drill the delineation and development wells. To increase the jack-up drilling unit's stability during development drilling, seafloor stabilizing lines will be used to attach the platform to the sea floor. (U.S. Dept. of the Interior, MMS, 1985, pp. II-6).

### *Production*

Assuming year-round production, gas would be produced from bottom-founded structures, thereby protecting the facility from moving sea ice. Depending on the water depth, seafloor conditions, ice conditions, and size of the reservoir, several types of facilities could be used.

Artificial and caisson-retained gravel islands could be used as production platforms in the shallower part of the basin (<50 ft. of water). Monopod or multiple-leg platforms built to withstand the environmental forces of the northeastern Bering Sea are other options, but the recommendation is to utilize the arctic subsea facilities due to depth, gas quantity, ice conditions, cost, and distance from market. (U.S. Dept. of the Interior, MMS, 1985, pp. II-6).

Other concepts have been developed for arctic production platforms that are based on monolithic, multi-sided concrete or steel structures or large monopod/monocone-type structures. A variety of steels that are designed for use in low-temperature environments are available for construction. In addition, concrete has been used in the construction of many different types of structures to provide resistance from the negative effects of seawater, ice and freeze-thaw cycles. Large-scale commercial production would be needed to justify the costs of these structures. The small three-well stand-alone field considered in this analysis would not support the costs of these facilities.

This analysis therefore assumes that the production facilities will be bottom-founded subsea production systems. Subsea production systems are used to bring produced gas to shore as opposed to a large offshore production platform. (Shell Exploration & Production Company, 2003; Statoil, 2003).

The gas is produced at the seafloor, and then multiple wells are 'tied-back' to the shore facilities using a combined single return line. The two producing wells and one disposal well will be connected to a manifold by gas gathering lines. The wells can be drilled by a moveable rig, and produced without having a large production platform. The modeled Norton Basin production facilities will stand on the seabed in water depths of 30-50 feet. These facilities will be partially buried to prevent ice-scouring, but will also utilize a protective shell that will still allow fast maintenance. The production system will consist of the subsea template, pipe manifolds and control cables that run from land to the field.

The output will be transported to a land-based gas processing distributing plant through a 40-mile pipeline. Both subsea production in the field and pipeline transport will be monitored and controlled from an onshore base in Nome. The operators will communicate with the production facilities using an umbilical. The umbilical will be able to open and close valves on the seabed 40 miles away with signals transmitted along fiber-optic cables, and with high-voltage electrical and hydraulic power lines. Such a system was used in Shell's Gulf of Mexico Mensa project (Shell Exploration & Production Company, 2003) and in Statoil's Barent Sea Snøhvit project (Statoil, 2003).

Gas from the modeled Norton Basin Field is assumed to contain 10% carbon dioxide based on $CO_2$ volumes observed in the nearby Y-0436 (13) ARCO well. During the production process of a gas with $CO_2$, a carbonic acid, $H_2CO_3$, is formed that will corrode all non-protected steel that the gas comes in contact with. All methane with a $CO_2$ volume higher than 2% is considered beyond acceptable corrosion limits. Hence, there will be a need to separate carbon dioxide from the gas produced. The $CO_2$ will be separated subsea, using a membrane or a subsea separation unit (depending on technological advancements). It will be directed into a separate gathering line and injected into well Y-0436, which was plugged and abandoned in 1980. (Moritis, 2003). There, it will be sequestered into shallow geological formations, including oil and gas reservoirs.

One other alternative for the disposal of $CO_2$ is being tested: direct injection of $CO_2$ into the deep-ocean to stimulate the passively floating or swimming minute plant life and to stimulate subsea chemical, biological, and de-carbonization systems. The utilization of this technique will depend on the advancement of the technology. (Moritis, 2003). The use of this technology would greatly reduce costs and has the potential to enhance sea life growth. (Markels, 2001).

***Pipelines***

Subsea pipelines would be used to transfer the gas from the offshore production facilities to onshore facilities. The pipeline required is estimated to be 30 miles in length in addition to 10 miles of flowlines to the production templates. The ice in Norton Sound is not thick or stable enough to support equipment used to lay pipe in the winter, therefore the pipeline would be laid from a special ship. Pipe laying will commence from landfall and the barge would work its way out to the field along a planned route (Statoil, 2003). The pipelines will be buried six feet below the seabed to prevent possible damage by ice gouging or current scouring. A trenching barge, plow, or dredge will be required to excavate the trench and cover the pipe (U.S. Dept. of the Interior, MMS, 1985, pp. II-7).

### *Onshore Facilities*

The shore based facility would consist of a simple supply base to support exploration, production, transportation activities, and gas storage/supply facilities. Facilities with these capabilities are already established in Nome, so very little additional expense is needed to establish the shore base. An onshore production monitoring station will be built to oversee production and a small gas storage facility will be built to store the gas for peak power generation and emergency shut-in periods (U.S. Dept. of the Interior, MMS, 1985, pp. II-7).

## D. ECONOMIC PARAMETERS, TAXES, & ROYALTIES

In 2000, the world price of crude oil more than doubled the average, to over $30 per barrel. There were protests over the high price of fuel by motorists, truckers, fishermen and farmers, who blockaded roads, ports and refineries. Politicians urged producers to increase production to bring the price down.

The price of energy is determined largely by economic, political, and business factors. Furthermore, these economic, political, and business factors control the economic feasibility of large scale projects such as oil discoveries in the National Petroleum Reserve, Alaska, and small-scale projects such as the Norton Basin Natural Gas project. With any economic analysis, proper parameters must be established to create a consistent comparison and evaluation. Some of these parameters include base year, geologic probability, inflation rate, discount rate and others.

### *Base Year*

The Base Year is defined as of January 1, 2004. This is the "present" in the sense of Net Present Value (NPV) analysis. End-of-Year accounting is used for the expenses (or income) during each year of the project.

### *Geologic Probability*

The results of the economic analysis are reported as unrisked and risked values; unrisked implies that there is no geological risk and risk implies that a specific risk factor was applied to the estimated resources and values. For instance, if there were a 47% risk factor for the Norton Sound resources then the chance that the resources and values would occur is 53%. For the purpose of the Norton Basin feasibility study, the geologic probability of a gas discovery is assumed to be 100%; therefore, unrisked and risked values are equal. (See appendix 1 cell D10). This analysis begins at the point of a significant gas discovery in the Norton Sound.

### *Inflation Rate*

Inflation is the increase in the price of goods and services as the economy grows. The inflation rate factors are used to increase the input values given in Base Year dollars to the actual nominal dollars "as-spent' or "as received" in the future, so that tax consequences are properly modeled. See appendices 4, 7, and 8 for conversion calculations from past year gas and oil prices to adjust to the Base Year. Inflation was also used to further define sunk costs in relation to base year 2004$.

Nominal development costs and petroleum prices are inflated into the future at the same rate. The model assumes a constant inflation rate for costs. Estimates for inflation are taken from the recent Energy Information Agency forecast, where annual inflation for the period 1998-2020 is expected to range from 1.7 - 2.9%, with a reference case of 2.27%, which is used in this study. (See appendix 1 cell N9).

***Discount Rate***

Discount rates are used to account for the time value of money. In discount cash flow models, the discount rate converts future cash flows to equivalent present values. Discount rates convert future inflows and outflows of revenues to a single value that can be used to compare alternative investments.

As tax regulations are likely to vary widely between different areas, discount rates can be adjusted to reflect area-adjusted after-tax investment returns. A downward adjustment of 24% commonly is used to convert before-tax to after-tax discount rates. The model inputs discount rates in real terms; therefore, the inflation factor is subtracted from reported nominal discount rates.

The most important component of the discount rate is the cost of capital. Risk premiums typically are added to the weighted average cost of capital (WACC) to provide a margin on the breakeven return. Minimum risk premiums used by the industry generally are 3-4% higher than the WACC. Standard risk premiums are 6-8% higher than the WACC. Maximum risk premiums could range upwards of 10%. (Gustavson, 1999; Miller, 1999). Risk premiums provide a margin for circumstances that are uncertain, including field performance (production rates, cost overruns), market factors (liquidity, future prices), and political risk (taxation, delays).

The following assumptions were used to define real, after-tax discount rates. The minimum discount rate is assumed to be the WACC (10%) plus a 3% risk premium, minus tax (2%) and inflation adjustments (2.3%), resulting in a real, after-tax minimum discount rate of 8.7%. The reference discount rate is defined by the WACC (10%) plus a 7% premium, minus tax (2%) and inflation adjustments (2.3%), resulting in a real, after-tax discount rate of 12.7%. The maximum discount rate is defined by the WACC (10%) plus a 10% risk premium, minus tax (2%) and inflation adjustments (2.3%), resulting in a real, after-tax discount rate of 15.7%. In the discounted cash flow (DCF) calculations, inflation rate is combined with real discount rates, producing overall discounting factors equal to 11.2%, 15.3%, and 18.4%. (These are figures that are used in calculations in appendices 1 and 4).

### *Oil and Gas Prices*

A standard reference for energy related forecasts is the Annual Energy Outlook published by the Energy Information Agency (Energy Information Agency, 2001). The current reference (AEO-2001) provides oil and gas price forecasts along with accompanying low-price and high-price ranges.

Prices can be reported in either real dollars or as nominal dollars. In the current model, prices are input as Base Year dollars (real 2004$). Future nominal prices can include inflation, and real changes in prices. Past petroleum prices are adjusted to 2004$ using the consumer price index (CPI) and factors published by the Bureau of Labor Statistics (Bureau of Labor Statistics, 2003).

The Norton Sound area is a closed market for natural gas sales, because there is no feasible competition with gas production from other regions. A cost comparison with imported LNG from Cook Inlet was performed, but this latter alternative is based on to-the-dock prices and used only to compare relative values. LNG from Cook Inlet would require an expensive re-gasification process further upstream (beyond the dock) in Nome, which would make any Norton Sound LNG project uneconomic. The closed market in the Norton Sound area requires an alternate method to calculate gas value for royalty and income tax purposes. (Sherwood, 2001).

Because there is no formal arrangement for gas valuation from Federal lands in rural Alaska, the Alaska State Department of Revenue (DOR) valuation formula is adopted for the Norton Basin analysis on a comparison basis and is not used in the specific Engineering and Economic Analysis of Natural Gas Production in the Norton Basin (State of Alaska, Dept. of Revenue, 2003c). Currently the DOR formula for gas value for production (severance) taxes, in the absence of a major gas sale off of the North Slope of Alaska, is set out in regulation 15 AAC 55.173. This regulation defines the prevailing (or tax) value for gas other than natural gas liquids (NGLs,) delivered in the Alaska North Slope area. The prevailing value per Mcf is 10 percent of the prevailing value that would be determined for the sale of a barrel of Alaska North Slope (ANS) oil at Pump Station number one of the Trans-Alaska Pipeline System (TAPS).

***Price adjustment of Alaska North Slope Crude Oil in the West Coast Market***

The Energy Information Agency (EIA) reports World Oil prices, which are a composite of refiner's acquisition costs for a market basket of domestic and foreign crude oil supplies. Relative to World Oil, ANS crude oil generally is sold at a lower price because of quality differences. In its primary market, the U.S. west coast, ANS competes with local (California) production and foreign suppliers. Approximately 90% of North Slope oil production is shipped to the west coast where ANS comprises about 50% of the refinery runs. (State of Alaska, Dept. of Revenue, 2003c).

The EIA World Oil prices data compare the average market price (2004$) with crude oil imported to the U.S and ANS oil. In the period 1982-1998, the price difference between ANS and a market basket of imports averaged -$0.66 per barrel ($0.66 below market price). Price adjustments for various crude oils sold to refineries on the west coast are published by Chevron Products Company. Using the Chevron pricing formula (-$0.15/API degree below 34°), given an ANS gravity of 28°, would yield a $0.90-per-barrel price adjustment for ANS in the west coast market. If we average the historical ANS price adjustments (-$0.66 per barrel) and current Chevron market guidelines (-\$0.90 per barrel), a value of \$0.78 per barrel is obtained. Thus, a World Oil market price of \$18.00 per barrel would be equivalent to an average landed west coast ANS price of \$17.22 (Craig, 2000, pp. D1-3; U.S. Dept. of Energy, EIA, 2001).

### *Price adjustment of Norton Basin Natural Gas*

The Norton Basin natural gas price is determined by comparing the average market price (2004\$) of 135,000 BTU/gal #2 Diesel fuel imported in Nome to the cost of producing gas into the Norton Sound area. Since the #2 Diesel fuel imported into Nome is derived from ANS crude oil, an adjustment that includes transportation and distribution costs to the Nome docks must be made from ANS crude oil price. To do this, the current 2004\$ price average of 135,000 BTU/gal #2 Diesel fuel in the Norton Sound over the last five years was first determined. The time value of money was then applied using the current inflation rate and a 2004\$ price average of 135,000 BTU/gal #2 Diesel fuel in the Norton Sound. The price of #2 Diesel was provided by the Nome Joint Utility System. (Handeland, 2003). Using linear regression, a forecast trend was created. Following this, an expected 2004\$ Norton Sound natural gas price was applied to adjust the linear trend in order to calculate the forecast price of Norton Sound natural gas during the time of production. (Albright, 2000, pp. 863-865). Using the provided information, the west coast market price was adjusted to an equivalent Norton Sound natural gas price. All prices are landed dock prices. The starting gas price in 2004 (first year of production) is estimated to be \$18.65/Mcf which converts to \$1.00/gal (2004\$) of diesel. The minimum historical Norton Sound diesel energy price (last six years) was 0.97/gal which converts to \$18.03/KWh on an energy basis. Expected 2005 diesel prices are expected to be \$1.30/gal which converts to \$24.24/KWh (2004\$). (See appendix 1 cells L22, N22, L25, N25, and appendix 9).

***Norton Sound Gas Assessment***

The Norton Basin gas analysis compares energy to the dock in Nome on a 2004$/KWh and gives data on a 2004$/BTU basis. Product storage and distribution costs are not taken into account. The BTU basis assesses costs on a heat output level and the KWh basis assesses costs on an electricity generation level.

The cost of energy from natural gas produced and sold to the Norton Sound market is the basic comparison factor of the Engineering and Economic Analysis of Natural Gas Production in the Norton Basin. This cost is directly compared with both the cost of energy from #2 diesel fuel currently being shipped to Nome and the expected price of liquefied natural gas (LNG) imported into Nome from the Cook Inlet. (Sherwood, 2001, pp. 53). If the cost of energy from natural gas produced and sold to the Norton Sound market is lower than #2 diesel fuel and LNG, then the project is expected to produce a profit to the investor. The analysis assumes a starting natural gas price of 18.65/Mcf on a on a KWh basis (equivalent to $1.00/gal of Norton Sound diesel), which is a strongly subjective figure. (See appendix 1 cells L22 and N22).It is calculated using market trends and industry forecasts. The minimum historical Norton Sound diesel price is $0.97/gal; therefore, any price of Norton Sound natural gas sold at a price lower than $0.97/gal will be a savings to the consumer. (Handeland, 2003).

***Power Cost Equalization (PCE)***

Power Cost Equalization is a program under which the State of Alaska (Alaska Statue

42.45.100) pays a portion of the electric bills for consumers served by utilities participating in the program. Participation in the PCE program is limited by statute to utilities meeting certain requirements. For example, during 1984, a utility must have used diesel-fired generators to produce more than 75 percent of the electric consumption of the utility; and, if a utility served a single community, its 1983 residential sales eligible for the PCE program could not have exceeded 7,500,000 kilowatt-hours (KWh). The Regulatory Commission of Alaska sets the PCE amount (cents/KWh) that is applicable to each qualifying utility participant's billings, regardless of whether the utility is otherwise subject to the Commission's economic regulation. The PCE amount varies according to the utility's rates and its costs of producing electricity. In most cases, the PCE per KWh is the same for all the customers of a utility, but it may vary by rate schedule. The PCE program reduces the effective rate per KWh up to 700 KWh per month per customer. Customers designated as "community facilities" are eligible for a PCE credit for actual consumption up to 70 KWh per month for each resident of the community. The PCE credit is applied on the customers' utility bill.  The PCE credit for community facilities is calculated in the aggregate for each community served by the utility. For example, if a utility served one community with a population of 150 and two community facilities, those two community facilities together would be entitled to PCE for their total consumption up to 10,500 KWh per month (150 x 70 = 10,500 KWh maximum [Alaska Energy Authority, 2003]).

In the Nome Joint Utility System, each consumer eligible under the PCE program requirements receives 4.30 cents/KWh.  This figure calculates to close to $300,000 annually to the Nome Joint Utility System based on the PCE guidelines.  This figure is not calculated into the Norton Sound energy cost figures in this analysis since it is assumed the amount will be applied no matter what source of energy the Nome Joint Utility System utilizes. Therefore, the NPV is calculated as if the government subsidy continues to apply for natural gas to the Nome Joint Utility System (Alaska Energy Authority, 2004).

### *Tangible Portion of Costs*

Tangible assets include facilities, equipment, wells, pipelines, and other components of the development project that can be appraised by inspection. Tangible assets are depreciated for tax purposes according to State and Federal regulations. The values used for the tangible portion of development items are typical for oil and gas industry. (See appendices 1 and 4).

### *Intangible Portion of Costs*

Intangible costs make up the remainder of the capital investments in a project (total costs minus the tangible portion). Intangible drilling costs (IDC) are expenditures that ordinarily do not have salvage value, such as logistics, rig costs, and supplies. These costs can be deducted in the year spent. The 1986 revisions to the Internal Revenue Service tax law now require that 30% of the IDC must be amortized over a 7-year period. As a simplifying assumption, the economic spreadsheet does not separate the 30% IDC fraction. Instead, adjustments are made to the tangible inputs to accommodate the 30% IDC fraction. For example, if the normal tangible allowance for a development well is 30% tangible and 70% is intangible, we would add the 30% IDC (or 21%) to the tangible fraction to give a combined input tangible fraction of 51%. Although IDC expenses are actually deductible on a 5-year schedule, this has a minor, conservative effect in the cash-flow calculations (Eschenbach, 2003, p. 314-317). (See appendix 1 cells H15-22 and appendix 4).

### *Modified Accelerated Cost Recovery Schedule*

The Modified Accelerated Cost Recovery Schedule (MACRS) is a timetable defined by the Internal Revenue Service that specifies the annual allowable deductions for tangible expenses, where total recovery is obtained over a 7-year period (Eschenbach, 2003, p. 314-317). (See appendix 1 cells H15-22).

### *Federal Tax Rate*

According to Internal Revenue Service regulations, the nominal tax rate for corporations is 35%. This rate is applied to the net taxable income, which is income after costs, royalty, tangible/intangible deductions, and State/local taxes (if applicable) have been subtracted. The tax calculations are specific to the individual project and do not account for the company's actual overall tax position based on all assets. (See appendix 1 cell L14).

### *State Tax Rate*

The model does not include any State corporate income tax that might be paid directly from the Norton Project. State severance tax is not included in the model, because Norton gas underlies Federal land. However, property tax is paid to the State of Alaska for infrastructure located on State lands (including offshore submerged land). The standard tax rate is 2% (20 mils) calculated on the current year tax base (depreciated value of tangible assets). Onshore pipelines or facilities are assumed to include property taxes in their tariffs. A separate spreadsheet is used to calculate ad valorem (property) tax based on the tangible portion of development items. (See appendix 1 cell L16 and appendix 6).

***Royalty***

Royalty from production is paid to the Federal Government following the conditions of the lease. In the case of Norton, the royalty rate is fixed at 12.5% of gross revenue (gas sales) minus transportation costs. (See appendix 1 cell L18). A royalty incentive program is likely if this project proceeds, but the program hasn't currently been approved. This analysis assumes a royalty rate of 0% after incentives as an alternative.

## E. INFRASTRUCTURE & PRODUCTION COSTS

The Arctic and deepwater frontier regions of Alaska are tormented by harsh environments and difficult operating conditions, greatly increasing the costs of gas exploration and development. Offshore exploration and development costs in Alaska are influenced by the ocean environment, distance from logistical support bases and production start up expenses. Facilities and associated development costs are reported in "as-spent" dollars. (See appendix 5). However, the model inputs are given in Base Year dollars. Because of inflation, as-spent costs will be somewhat higher in the future than the inputs in Base Year dollars. Program iteration is required to adjust the desired "as-spent" amounts to constant dollar inputs. End-of-year accounting is used throughout the DCF model. (See appendices 3 and 4).

### *Sunk Costs*

Sunk costs are past expenses associated with the Norton Project. Sunk costs include lease acquisition and appraisal costs. Expenses associated with seismic surveys, tract rentals, and environmental/engineering studies in support of permitting requirements are also allowable, if they occurred within this period. Sunk costs in the model are separated into lease (anticipated bonus bid and rentals) and appraisal costs (exploration well costs, environmental/engineering studies, seismic surveys, and exploration well costs). Exploration costs include all costs involved with drilling an exploratory well. Exploration wells are wells drilled to prove the existence of a hydrocarbon-bearing formation and often referred to as wildcat wells. The activities associated with an exploration well include geological studies, coring, and the physical drilling. Sunk costs are inflated forward to the Base Year from the year spent using the inflation factors published by the Bureau of Labor Statistics. The only sunk costs associated with the Norton Sound project are the lease cost and exploration costs, which are estimated to be \$0.50 million for the lease and \$9.75 million for the appraisal costs (2004\$). (See appendix 1 cell B29 and B30, appendices 3, 4, and 5). These costs could very likely evaporate under government subsidization programs. (Eschenbach, 2003, pp. 249-251).

### *Exploration-Production, Development, & Extended-Reach Well Costs*

Exploration-production, development, and extended-reach (ERW) well costs include all expenses associated with planning, drilling, evaluation, and completion activities. Exploration-Production is the conversion of exploration wells (not the actual exploration costs) to production wells. (See appendix 1 cell C33, C34, and C35, appendices 3, 4, and

5).

A. Exploration-production wells are wells commenced with the first commercial quantities of hydrocarbons flowing through the wellhead. This marks the turning point from a cash flow point of view, when revenue generation begins and can be used to offset project investments. The costs of converting exploration wells into production wells are included under the exploration-production well cost. The estimated exploration-production well costs are $3.50 million per well for this project. (Jahn, 2000, pp. 277-290). (See appendix 1 cell C33).

B. Development wells include production and injection wells. Offshore production wells are often deviated to ensure the entire reservoir is drained. According to general definitions, conventional development wells vary in trajectory from vertical to sail deviation angles approaching 60 degrees. A wealth of experience within the oil and gas industry in drilling conventional wells has resulted in better constrained cost estimates and lead to estimated development well costs of $3.50 million per well. (Langenkamp, 1981, pp. 54). (See appendix 1 cell C34).

C. A new class of wells called extended-reach wells (ERW) is used increasingly by industry to reach subsurface targets when surface constraints restrict the optimum location of facilities directly over gas pools. ERW wells can also reduce numbers of platforms or onshore drilling pads available to produce large pools. ERW are defined as having departure ratios (or horizontal reach to vertical depth ratios) of greater than 1.5. For example, a well drilled to 8,000 feet (true vertical depth) to reach a reservoir target 12,000 feet away from the rig location would be considered an extended-reach well (departure ratio of 1.5). This project does not utilize or assume any ERWs because the high cost of these types of wells is not justified unless a substantial number of wells are drilled (more than 3). (Jahn, 2000, pp. 364). (See appendix 1 cell C33).

***Platform Cost***

All costs associated with the installation of the production facilities are summed under this category, including costs associated with engineering, permits, site preparation, production equipment, on-site infrastructure, logistic support, project management prior to field startup, etc. These costs support the use of the production drilling platform and the subsea production facilities. The platform cost is estimated to be $30 million as spent. (See appendix 1 cell J30, appendices 3, 4, and 5).

***Pipeline Cost***

This category includes all costs associated with engineering, design studies, route surveys, right-of-way, permits, materials, trenching, installation, shore crossings, hook-up, and project management prior to field startup. All pipelines and communication links installed in the alignment are included in the overall costs. The pipeline constructed to transport the methane gas to shore will be 4.5 inches in diameter and the estimated as spent cost of all the above-mentioned factors will be $45 million. (See appendix 1 cell J33, appendices 3, 4, 5, and 10). The Norton pipeline is treated as a capital cost, so a State property tax is levied on the segment crossing State waters.

***Shore Base Cost***

Costs associated with a new logistic support base, including such things as airstrips, docks, warehouses, communication and monitoring systems, and crew quarters, are summed under this category. However, because development logistics for the Norton project will be handled from existing infrastructure, no extra shore base costs are included in this analysis except for the production monitoring station. Storage facilities would be needed to maintain constant flow rates throughout peak times. However, these expenses would normally be included in the distribution costs. The expected as spent shore base cost is estimated to be $3 million. (See appendix 1 cell N29, appendices 3, 4, and 5).

***Abandonment Cost***

Abandonment costs generally include removing production equipment, dismantling onsite facilities, plugging wells, decommissioning the pipeline, and restoration of the site. The model assumes reasonable abandonment costs, recognizing that the abandonment requirements could vary according to regulations in effect at the end of production. No implication is made here about the scope of abandonment activities for the Norton project. The total as spent abandonment cost is estimated to be $24 million. (See appendix 1 cell N32, appendices 3, 4, and 5).

***Storage & Distribution***

To maintain consistent production flow rates and to allow continuous power generation through emergency time periods such as pipeline breakage, a small-volume storage facility may have to be built. This cost was not included in the Norton Sound assessment since it is assumed that the local power cooperative would pay for this cost as a utility cost. Distribution costs were also not included either due to the fact that the current electrical distribution lines will be used to transport power to the existing residential and commercial appliances and heating units. If consumers choose to convert to home heating, a large scale storage facility may be required to overcome the oscillation of the winter demand.

### *Operating Costs*

Operating costs include production startup, facilities maintenance and repair, fuel, labor, supplies, well workovers, pipeline inspection and maintenance, transportation, communication, and project management. Operating costs are scaled into two components: a variable component tied to gas production rates, and a fixed component tied to the number of wells. The fixed component reflects the overall size of the production facilities and is estimated to be $5.45 million/well/yr. The variable component is estimated to be $5.00 /Mcf. This includes all $CO_2$ sequestration. (See appendix 1 cell C44, appendices 3, 4, and 5).

### *Transportation Costs*

No tariff is set on this pipeline (for Norton Basin gas) because the pipeline cost is covered as a capital investment and operating costs are included under facility operating costs. The main assumption for this study is that gas will be entirely consumed in the greater Norton Sound area. Feeder pipelines move the Norton Basin gas exclusively to Nome and other Norton Sound markets. The transportation costs are expected to be $1.38 /Mcf. (See appendix 1 cell H42, appendices 3, 4, and 5).

## F. ECONOMIC ANALYSIS

The economic viability of the Norton Project is determined by the cash flow it generates. The development expenses represent the negative cash flows. The income stream from production is represented by the positive cash flows. Production income is determined by both the production profile (production rates) and gas prices. High gas prices will support project viability despite higher costs. Conversely, low gas prices could eliminate viability even with costs at expected levels.

Because gas fields can produce for decades, it is important to take a long-term perspective, considering average prices over a long time horizon rather than stressing temporary price spikes that may be of short duration. For a discount cash flow analysis, the most important period is early in the production life of the well/field when flow rates are near maximum and discounting (i.e. allowing for the diminished present value of future investment income) is less. Neglecting discounting, the most important time for economic viability would be at the end of the well/field life when low prices could lead to premature abandonment. For the Norton Basin Project, the period of high prices extending from production startup to the year 2017 is most important for economic viability because a majority of the reserves will be produced during that time.

Accurately predicting future commodity prices is another important and difficult aspect in project assessments. Long-term viability cannot be accurately predicted using a short-term perspective. Very few economic experts predicted the drastic swings in hydrocarbon prices over the last few years. Before 2000, the average gas prices were relatively low and stable. Since 2000, gas prices have been above $3 per Mscf. (See appendix 19).

To help remove the subjectivity of commodity price forecasting, some criterion must be devised to establish a forecasting basis. One way to do this is to plot prices versus time and fit a curve through the points that minimizes the discrepancy between the data points and the data based predicted curve, using a technique called least-squares regression. The simplest example of a least-squares regression is fitting a straight line to a set of paired observations. If the price data has a strong (high percentage or within an acceptable range) coefficient of determination ($R^2$, a measure of the goodness of fit of the least squares line) then a linear trend line can be acceptably projected to a specified future year and a statistically suitable estimate of a corresponding gas and oil price can be made. (See appendix 19). The least-squares regression method is favored for predictions of both oil and gas prices in Alaska because it is based on actual data for Alaska operations, gas history and inflation.

A great deal of uncertainty surrounds the determination of future hydrocarbon prices. No one is more aware of the consequences of inaccurate forecasts than an investor who is asked to commit major sums of money to a new project; so the investor employs conservative assumptions that lead to more prudent investment decisions. Successful investments are expected by the investor.

## G. BENEFITS

Beyond possible consumer economic savings, the principal benefits of the expectation of a consistent supply of gas-fired power from the Norton Sound project with the Norton

Sound area will be several: increases in employment; increases in the population in the area; decreasing dependency on fuel transportation for their energy needs; and increased potential for a new, local economic enterprise, powered by clean burning natural gas.

New companies would establish new jobs that increase the cash flow within the area. In addition, the more new companies start up due to the addition of natural gas in the area, more energy savings is passed to the consumers (capital costs spread out more among users). If gas volumes are in excess of original estimates, there will also be potential for new power-dependent industries to start-up and grow in the Norton Sound area. All of the businesses in the area would benefit from consistent power even under severe weather constraints or heavy energy load situations.

This paper outlines natural gas production for electrical generation, but there is also potential for an individual consumer gas distribution system for both residential and commercial heating. At present, a high percentage of Norton Sound consumers use propane for space heating. Propane heating systems can easily and inexpensively be converted to run on natural gas, so the benefits of natural-gas-fired space heating would easily be extended to the consumers.

There is also likelihood for Enhanced Oil Recovery (EOR) in potential neighboring hydrocarbon wells within the Norton Sound Basin using $CO_2$ injection. Since the Norton Sound project will produce 10% $CO_2$ (Bcf), the attractiveness of this already proven technology for new oil and gas field investors is high. $CO_2$ injection into shallow gas reservoirs such as the Norton Sound gas fields has potential for improving gas recovery.

$CO_2$ injection projects have substantial life-spans, many of them 10-30 years. Expected additional oil recoveries resulting from these projects are on the order of 7-15% of original oil in place. Government relief also has been key to the use of more $CO_2$ (that results from the influence of human beings (release of $CO_2$ from industry activities)) for U.S. EOR projects. One example incentive is Internal Revenue Service's Section 29 tax incentive which began in 1980 to encourage unconventional oil and gas domestic production (Moritis, 2003).

## H. ECONOMIC MODEL BASELINES

A majority of Norton Sound's energy is derived from diesel/electric generators. As a first check on economic viability, the break-even price required for the Norton Basin Project was defined by the current, diesel-based price of energy in the Norton Sound area, and was modeled on a basis of both 2004$/KWh with 2004$/BTU being secondary analysis. In the assessment of alternative fuel costs, the break-even price was set equivalent to the current price of energy/fuel in Nome. Profit can be awarded to the investor or passed on to the consumer, and so a positive NPV can lead to either profit for the investor or savings to the consumer. Profit can be further increased by higher future market prices or a lower cost of capital due to access to government loans or grants.

## I. ECONOMIC MODEL RESULTS

Various criteria can be used to evaluate the economic viability of gas development projects. Some of the more common measures of the project cash flow are given under the results column in the summary sheets. The summary sheets also show cumulative and annual cash flows graphically. (See appendices 1, 3, and 4). The maximum negative cash flow[3] of the project is $60.92 million. (See appendix 4 cell AG51). The total net positive cash flow[4] is $319.32 million. (See appendix 4 cell AG54). The P/I[5] ratio for the Norton project is 3.37 which indicates a risky project. (See appendix 1 cell F84). The NPV[6] is $16.56 million. (See appendix 1 cell F83).

One thing should be kept in mind. This project is assessed under the assumption that there is 100% geological probability. If either exploration well is dry, then the project will die. Many would argue a 100% geological probability is not a realistic percentage to apply to a project of this stature. In response to this, the NPV, if a 50% geological probability was applied, is $7.03 million. The total net positive cash flow is $157.88 million. The P/I ratio for the Norton project is 1.86 which, again, indicates a risky project.

## J. POTENTIAL PROFIT MARGIN INCREASES

The study shows that under the given engineering and economic conditions the Norton Basin Natural Gas Project is currently economically viable, but only slightly. Even though the project shows a small NPV and weak P/I ratio, the project does have potential

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[3] Maximum Negative Cash Flow is the maximum cumulative expense incurred for the Norton Basin gas project. The actual dollar amount is given in after-tax, undiscounted dollars. This is represented by the low spot in the cumulative cash flow.
[4] Total Net Cash Flow (also called Actual Value Profit) is the actual net profit earned on the investment in after-tax, undiscounted dollars; represented by the flat, late-life portion of the cumulative cash flow curve. (See appendix: pg 1).
[5] Profit/Investment (P/I) ratio is defined here as the ratio of Actual Value Profit to Maximum Negative Cash Flow. Investments that have higher P/I ratios will be more attractive than those with low P/I ratios. Investments with P/I ratios less than 1.0 (where out-of-pocket expenses are greater than future profits) are risky (and likely unprofitable).
[6] Net Present Value (NPV) is actual expenses and future income (money-of-the-day) that is discounted to present dollars and summed to the net value of the investment. NPV is the most widely-used measure of viability.

for further profits.

The Environmental Protection Agency (EPA) is proposing a comprehensive national program to reduce emissions from non-road diesel engines by combining manipulation engine controls with reduced sulfur fuel in a system to gain the greatest emission reductions. The proposed emission standards would apply to diesel engines used in most kinds of construction, agricultural, and industrial equipment. Because the recommended emission control devices can be damaged by sulfur, EPA is proposing the reduction of the allowable level of sulfur in the non-road diesel fuel by more than 99 percent. The proposed standards would take effect for new engines starting as early as 2007 and be fully phased in by 2014. This would directly affect the Norton Sound area by increasing landed diesel #2 fuel costs and possibly requiring the replacement of current generation units with new units that have integrated advanced emission control technologies. This could cause the use of natural gas to become economical, as it simultaneously contributes to the reduction of emissions. In addition, EPA will be providing further incentives to encourage economic feasibility (Environmental Protection Agency, 2003).

The project has the ability for an additional margin of profit. The amount of risk involved with a project such as this may require State of Alaska and Federal Government assistance which would lead to lower financing costs. For example, the Minerals Management Service has provided incentives for high cost/high risk exploration for natural gas targets in the Gulf of Mexico since 1995 (Deepwater Royalty Relief Act of 1995) and is considering similar measures for Alaska OCS (“Petroleum News Alaska”, 2003, p. 1). Zero bonus bids/leases and 0% royalty gas are two possible options for this project. The Department of the Interior has also in the past incurred most of the exploration costs in selected government-funded exploration energy projects. If this happened with the Norton Sound project, investor costs would greatly decrease and the economics of the project would greatly improve.

This report outlines the Norton Basin Project, from a Federal perspective, to provide energy for rural villages from OCS waters. A more optimistic alternative may be closer to shore in state waters, state lands, or native lands, provided economic gas resources could be located there. The Norton Basin Project's chances of positive economics would greatly increase as the project lies closer to shore (on an economic standpoint). According to the USGS (Troutman and Stanley, 2002) there was one well drilled on land close to Nome in 1906 that found high pressured gas near the surface. Unfortunately, from the formation pressure trend seen in the Norton Basin analysis, there would not be enough formation pressure to propagate economic natural gas production rates and volumes in production wells progressively closer to Nome.

## K. CONCLUSIONS

In summary, the Engineering and Economic Analysis of Natural Gas Production in the Norton Basin study portrays a grim view of natural gas production in the Norton Sound Basin, but only under current conditions. This study has also outlined capabilities for decreasing the affordable energy gab between consumers and industry in the Norton Sound area. Energy independence is in sight of the Norton Sound Basin. When further government subsides and rising oil prices become true, conditions will then be ripe for the development of natural gas in the Norton Sound Basin.

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## Appendix 1: Main Sheet

INPUTS

| | | | |
|---|---|---|---|
| **Project:** | **Nome** | **Case (Alternative):** | |
| **Planning Area:** | **Norton Sound** | **Analyst:** | **Cameron Reitmeier** |
| **Company:** | **US-DOI-Minerals Management Service** | **Date of Analysis:** | **01-Jan-05** |

**Description:** This is the Main Sheet that shows a minor economics description of the bottom line NPV value and investment ratio.

### Economic Parameters

| | | | | Suggested Distribution | | | to be used |
|---|---|---|---|---|---|---|---|
| **Base Year:** | 2004 | **Inflation Rate** | | 1.70% | 2.30% | 2.90% | 2.27% |
| **Geologic Probability (1- Risk):** | 100% | **Real, After-Tax Discount Rate:** | | 8.00% | 10.00% | 12.00% | 10.00% |

### Tax and Royalty Inputs

| **Tangible Portion of Costs:** | with IDC | w/o IDC | **MACRS Schedule:** | | | |
|---|---|---|---|---|---|---|
| Lease (bonus bid): | 0% | 0% | Year 1: | 14.29% | **Federal Tax Rate:** | 35.00% |
| Delineation/Appraisal (wells & seismic): | 0% | 0% | Year 2: | 24.49% | **State Tax Rate:** | 0.00% |
| Exploration well converted to producer: | 51% | 30% | Year 3: | 17.49% | **Property Tax Rate:** | 2.00% (use AdValorem sheet) |
| Development Well: | 51% | 30% | Year 4: | 12.49% | | |
| ERD Well: | 51% | 30% | Year 5: | 8.93% | **Royalty Rate:** | 12.50% |
| Platform & Production Equipment: | 72% | 60% | Year 6: | 8.92% | | |
| New Shore base: | 83% | 75% | Year 7: | 8.93% | | |
| Pipeline: | 100% | 100% | Year 8: | 4.46% | | |
| Abandonment: | 0% | 0% | | | | |

| | (2004$/Mcf) KWh based | (2004$/Mcf) BTU based | (2004$/gal) |
|---|---|---|---|
| **Expected Starting 2005 Norton Sound $** | $18.65 | $7.41 | $1.00 |
| **Min. Historical Norton Sound Diesel price in the last six years** | $18.53 | $7.36 | $0.99 |
| **2004 Norton Sound Diesel $** | $19.64 | $7.80 | $1.05 |

### Infrastructure Costs

**Sunk Costs** ($MM):

| | |
|---|---|
| Lease: | $0.50 |
| Appraisal: | $9.75 |

**Platform Cost** ($MM): (Production Drilling Platform & Production Facilities)

| water depth | minimum | most likely | maximum | to be used |
|---|---|---|---|---|
| 50 - 75 ft | $18.00 | $30.00 | $42.00 | $30.00 |

**As-Spent Costs ($MM):**

| | |
|---|---|
| Shore base: | $3 |
| Platform: | $32 |
| Pipeline: | $47 |
| Abandonment: | $24 |

**Well Costs** ($MM/well) 1

| | |
|---|---|
| Converted Production: | $3.50 |
| Development: | $3.50 |
| Extended Reach well: | $0.00 |

**Shore base** ($MM): $3.00

**Total # of Wells**

| | |
|---|---|
| Production | 2 |
| Conventional | 1 |

**Transportation Cost** ($MM):

| | |
|---|---|
| Unit cost ($MM/mi): | $1.13 |
| Flow Line (mi): | 6 |
| Pipeline (mi): | 40 |
| Prod. Tubing Dia. (in | 3 |
| Pipeline Dia. (in): | 4.5 |

**Total Development Cost :**

| | |
|---|---|
| As-spent ($/Mcf): | $4.31 |
| Constant ($/Mcf): | $3.67 |

### Production Scenario

**Operating Costs:**

| | | |
|---|---|---|
| Variable (per-unit): | | |
| $CO_2$: | 0.5 | $/Mcf |
| Total Gas: | $5.00 | $/Mcf |
| Fixed (facility) (per-well bas | $5.45 | $MM/well/yr |

**Total Operating Cost:**

| | | |
|---|---|---|
| As-spent: | $5.00 | ($/Mcf) |
| Constant$: | $3.59 | ($/Mcf) |
| As-spent: | $163.54 | |
| Constant$: | $117.30 | |

**Transportation Costs:**

| | | |
|---|---|---|
| Gas: | $1.38 | $/Mcf |
| **Field Life:** | 30 | years |
| **Abandonment ($MM):** | $11.18 | |

**Current Norton Sound Energy Requirements:** 1.8 MMgal/yr

| **BTU basis** | **KWh/basis** |
|---|---|
| 243 BBTU/yr | 28.44 GWh/yr |
| 0.67 BBTU/d | 77.92 MWh/d |
| 243 MMscf/yr | 97 MMscf/yr |
| 666 Mscf/d | 264 Mscf/d |
| 7.29 Bscf/30yr | 2.90 Bscf/30yr |

| **Combined Rates:** | | **Per prod. well** | |
|---|---|---|---|
| Peak: | 2.24 | 1.12 | (Bcf/Y) |
| | 6.15 | 3.08 | (MMcf/d) |
| Average: | 0.88 | 0.44 | (Bcf/Y) |
| | 2.42 | 1.21 | (MMcf/d) |

### Notes

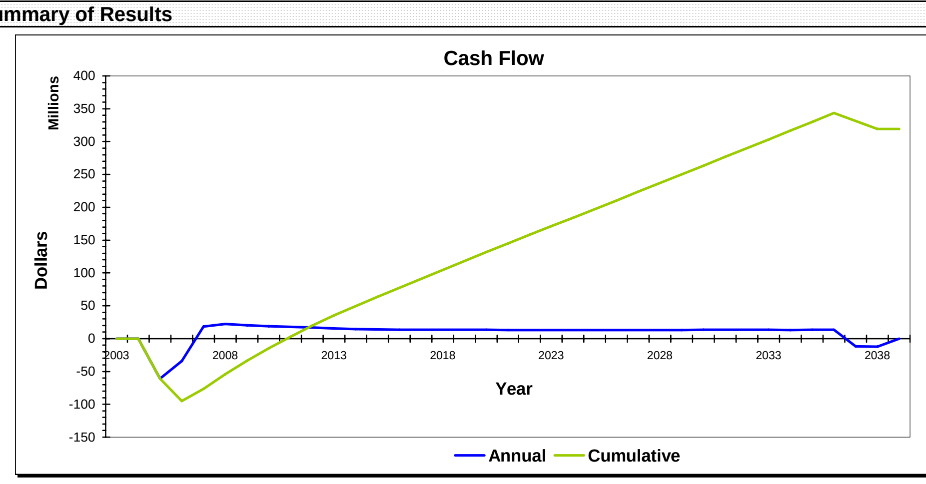
**Cells with black fonts contain calculations or guidelines.**

(1) Costs and prices are input in 2004$ (blue) and inflated to the year as-spent (black). End-of-year accounting is used.
(2) Expenses prior to the Base Year (Sunk costs) are inflated to constant Base Year dollars.
(3) Development cost categories include all expenses associated with activity: management, engineering, studies, materials, installation, logistics.
(4) Operating costs include all expenses associated with transportation, communication, maintenance, repair, project management, inspections, well workovers, supplies.
(5) Property tax should be included for all project infrastructure located on State lands (use Ad Valorem sheet).

### Summary of Results

RESULTS

| | Unrisked | Risked |
|---|---|---|
| **Estimated Resources:** | | |
| Methane (Bscf): | 29.44 | 29.44 |
| $CO_2$ (Bscf): | 3.27 | 3.27 |
| **Estimated Values (MM$):** | | |
| Net Income (BFIT): | $748.25 | $748.25 |
| Income to Fed. & State Governments: | $344.69 | $344.69 |
| Taxes: | $251.16 | $251.16 |
| Royalties: | $93.53 | $93.53 |
| **Net Present Value (MM$):** | | |
| NPV of Net Income (BFIT): | $133.65 | $133.65 |
| NPV Income to F&S governments: | $55.26 | **$55.26** |
| NPV of Taxes: | $38.56 | $38.56 |
| NPV of Royalties: | $16.71 | $16.71 |
| NPV of Cash Flow: | $16.56 | **$16.56** |
| Profit/Investment Ratio | 3.37 | 3.37 |



## Appendix 2: Energy Prices
## Graphical representation of energy prices (past and future) represented in $/MBTU and $KWh.

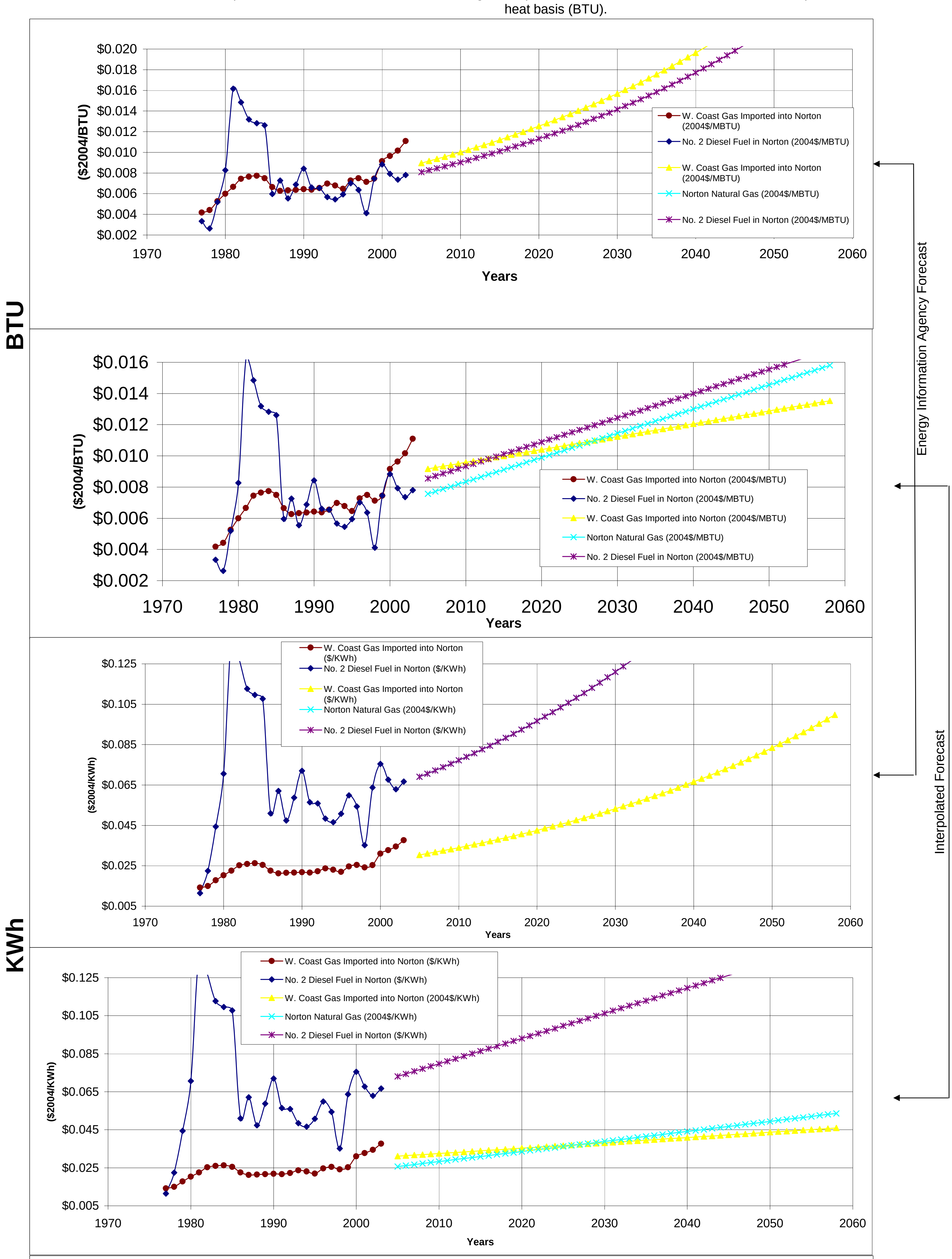
**PRICE OF ENERGY**

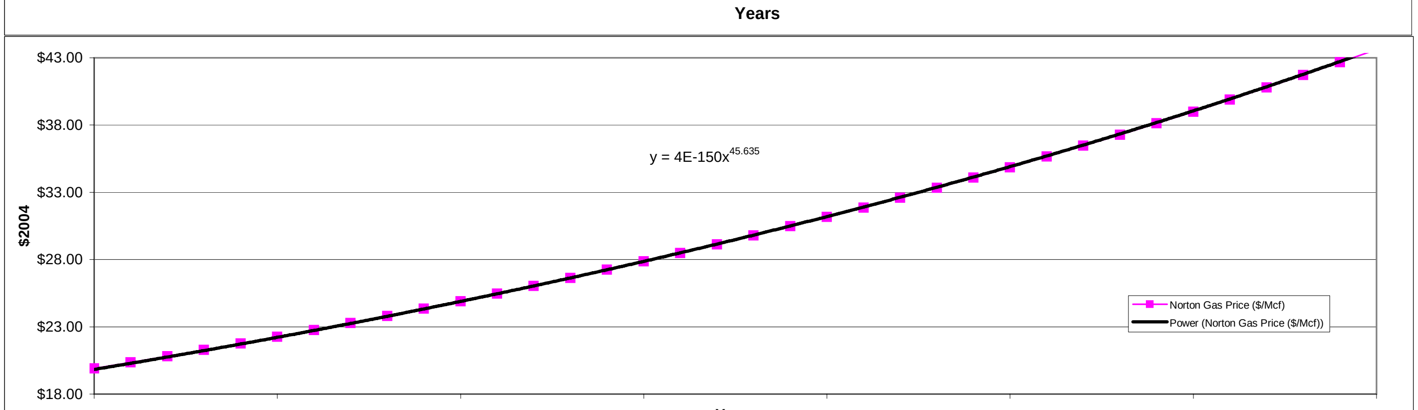
| | | | A | B | C |
|---|---|---|---|---|---|
| All in 2004$. | | 1 | **(2004$/Mcf) KWh based** | **(2004$/Mcf) BTU based** | **(2004$/gal)** |
| **Expected Starting 2005 Norton Sound $** | | 2 | $18.65 | $7.41 | $1.00 |
| **orical Norton Sound Diesel price in the last** | | 3 | $18.53 | $7.36 | $0.99 |

W. Coast Gas Imported into Norton = This is the price of natural gas if it was imported into Nome as LNG. This is strictly a transportation cost of $5.00/Mcf and does not take into account the conversion process. This is the upper limit in the price future/project

No. 2 Diesel Fuel in Norton = This is the price of (135,000 BTU,15.8 KWh)/gal diesel in the Norton Sound area forecasted from actual to-the-dock diesel prices in Nome.

Norton Market Natural Gas = This is the price of natural gas sold in Nome at the to-the-dock prices. Since its competing market is diesel, the price sold would be consistent with existing diesel prices for the final NPV. Note: Diesel is less expensive on a heat basis (BTU).



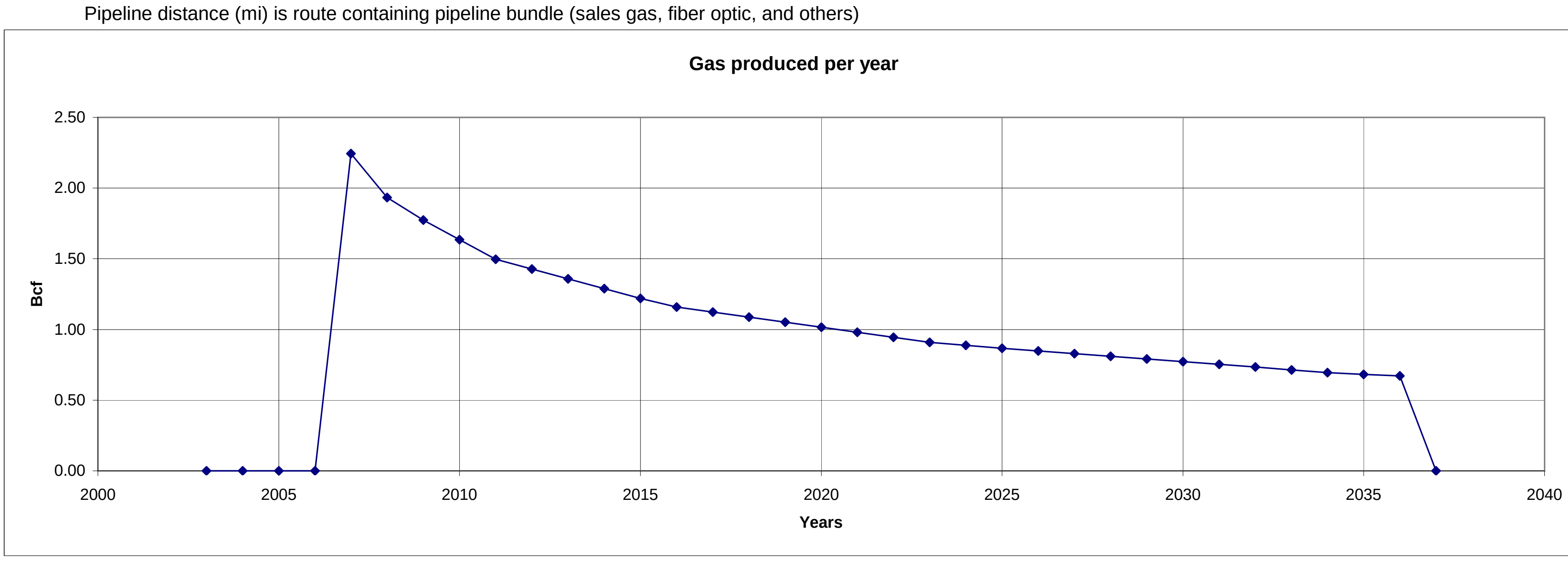



# Appendix 3: Development Schedule
## Shows the project schedule and production schedule.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sunk Costs | | | Field | Oil and Gas | Number of Prod. & Dev. Wells | | | | Number of Shore bases | Miles of Pipeline | Ann. Prod. Gas | Ann. Prod. $CO_2$ | Ann. Prod. Methane | Total Prod. Methane | Total Prod. Gas | |
| | Year | | Lease | Appraisal | Prod-wells | Abandonment | Platforms | Prod. | Conv. | ERD | Total | Constructed | Laid | (Bcf) | (Bcf) | (Bcf) | (Bcf) | (%) | Year |
| 1 | 2003 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0% | 2003 |
| 2 | 2004 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0% | 2004 |
| 3 | **2005** | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 40 | 0.00 | 0.00 | 0.00 | 0.00 | 0% | 2005 |
| 4 | 2006 | | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.000 | 0% | 2006 |
| 5 | 2007 | | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 2.24 | 0.22 | 2.02 | 2.020 | 6% | 2007 |
| 6 | 2008 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.93 | 0.19 | 1.74 | 3.759 | 11% | 2008 |
| 7 | 2009 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.77 | 0.18 | 1.60 | 5.356 | 16% | 2009 |
| 8 | 2010 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.63 | 0.16 | 1.47 | 6.827 | 21% | 2010 |
| 9 | 2011 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.50 | 0.15 | 1.35 | 8.173 | 25% | 2011 |
| 10 | 2012 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.43 | 0.14 | 1.28 | 9.458 | 29% | 2012 |
| 11 | 2013 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.36 | 0.14 | 1.22 | 10.680 | 33% | 2013 |
| 12 | 2014 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.29 | 0.13 | 1.16 | 11.840 | 36% | 2014 |
| 13 | 2015 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.22 | 0.12 | 1.10 | 12.938 | 40% | 2015 |
| 14 | 2016 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.16 | 0.12 | 1.04 | 13.982 | 43% | 2016 |
| 15 | 2017 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.12 | 0.11 | 1.01 | 14.994 | 46% | 2017 |
| 16 | 2018 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.09 | 0.11 | 0.98 | 15.973 | 49% | 2018 |
| 17 | 2019 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.05 | 0.11 | 0.95 | 16.920 | 52% | 2019 |
| 18 | 2020 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.02 | 0.10 | 0.91 | 17.834 | 55% | 2020 |
| 19 | 2021 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.98 | 0.10 | 0.88 | 18.717 | 57% | 2021 |
| 20 | 2022 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.94 | 0.09 | 0.85 | 19.567 | 60% | 2022 |
| 21 | 2023 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.91 | 0.09 | 0.82 | 20.384 | 62% | 2023 |
| 22 | 2024 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.89 | 0.09 | 0.80 | 21.183 | 65% | 2024 |
| 23 | 2025 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.87 | 0.09 | 0.78 | 21.964 | 67% | 2025 |
| 24 | 2026 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.85 | 0.08 | 0.76 | 22.728 | 69% | 2026 |
| 25 | 2027 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.83 | 0.08 | 0.75 | 23.474 | 72% | 2027 |
| 26 | 2028 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.81 | 0.08 | 0.73 | 24.204 | 74% | 2028 |
| 27 | 2029 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.79 | 0.08 | 0.71 | 24.916 | 76% | 2029 |
| 28 | 2030 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.77 | 0.08 | 0.69 | 25.610 | 78% | 2030 |
| 29 | 2031 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.75 | 0.08 | 0.68 | 26.288 | 80% | 2031 |
| 30 | 2032 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.73 | 0.07 | 0.66 | 26.948 | 82% | 2032 |
| 31 | 2033 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.71 | 0.07 | 0.64 | 27.592 | 84% | 2033 |
| 32 | 2034 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.70 | 0.07 | 0.63 | 28.217 | 86% | 2034 |
| 33 | 2035 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.07 | 0.61 | 28.832 | 88% | 2035 |
| 34 | 2036 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.67 | 0.07 | 0.60 | 29.437 | 90% | 2036 |
| 35 | 2037 | | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.000 | 0% | 2037 |
| 36 | 2038 | | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.000 | 0% | 2038 |
| 37 | 2039 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.000 | 0% | 2039 |
| 38 | | | | | | | | | | | | | | | | | | | |
| 39 | **Average:** | | | | | | | | | | | | | **0.88** | **0.09** | **0.80** | | | |
| 40 | **Total:** | | 1 | 1 | 0 | 1 | 1 | 2 | 1 | 0 | 3 | 1 | 40 | **32.71** | **3.27** | **29.44** | | | |

**Notes:**

Sunk costs are entered as exploration wells (inflated forward to Base Year)
Productive wells are exploration wells converted to producers
Development wells include producers, injection, and disposal wells
Shore base includes new controls facility
Pipeline distance (mi) is route containing pipeline bundle (sales gas, fiber optic, and others)



# Appendix 4: Discounted Cash Flow Worksheet

## Shows the project cash flow.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Wellhead price = Market price- transportation cost | | | | |
| | | | | | | | Total Cost 0f Production Wells | Total Cost 0f Development Wells | Total Cost 0f ERD Wells | Total Cost 0f Shore bases Constructed | Total Cost 0f Pipeline ($MM) | Total Annual Costs ($MM) | Gas Price ($/Mcf) | | | **Annual Income using Market Price** | **Net Incom** (Annual Incon |
| | | Sunk Costs | | | Abandonment | Total Cost 0f Gas Platforms | | | | | | | | @ Market | | | |
| | Year | Lease | Appraisal | Prod-wells | | | | | | | | | @ Market | w/constraint | @ Wellhead | Gas Total | **Annual** |
| 1 | 2003 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | | | | | $0 |
| 2 | 2004 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $21.88 | $21.88 | $20.47 | $0 | $0 |
| 3 | 2005 | $522,948 | $10,197,493 | $0 | $0 | $0 | $0 | $0 | $0 | $3,137,690 | $47,065,351 | $60,923,482 | $22.38 | $22.38 | $20.94 | $0 | $0 |
| 4 | 2006 | $0 | $0 | $0 | $0 | $32,088,871 | $0 | $1,871,851 | $0 | $0 | $0 | $33,960,722 | $22.89 | $22.89 | $21.41 | $0 | $0 |
| 5 | 2007 | $0 | $0 | $0 | $0 | $0 | $7,657,299 | $0 | $0 | $0 | $0 | $7,657,299 | $23.40 | $23.40 | $21.90 | $47,286,481 | $36,062,253 |
| 6 | 2008 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $23.94 | $23.94 | $22.40 | $41,626,600 | $31,965,067 |
| 7 | 2009 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $24.48 | $24.48 | $22.91 | $39,083,780 | $30,213,705 |
| 8 | 2010 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $25.03 | $25.03 | $23.42 | $36,834,349 | $28,660,261 |
| 9 | 2011 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $25.60 | $25.60 | $23.96 | $34,462,711 | $26,984,610 |
| 10 | 2012 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $26.18 | $26.18 | $24.50 | $33,622,420 | $26,488,529 |
| 11 | 2013 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $26.78 | $26.78 | $25.06 | $32,727,630 | $25,937,663 |
| 12 | 2014 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $27.39 | $27.39 | $25.62 | $31,774,921 | $25,328,878 |
| 13 | 2015 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $28.01 | $28.01 | $26.21 | $30,762,127 | $24,660,008 |
| 14 | 2016 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $28.64 | $28.64 | $26.80 | $29,893,550 | $24,095,294 |
| 15 | 2017 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $29.29 | $29.29 | $27.41 | $29,626,654 | $24,007,665 |
| 16 | 2018 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $29.96 | $29.96 | $28.03 | $29,332,254 | $23,892,533 |
| 17 | 2019 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $30.64 | $30.64 | $28.67 | $29,009,239 | $23,748,787 |
| 18 | 2020 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $31.33 | $31.33 | $29.32 | $28,656,463 | $23,575,279 |
| 19 | 2021 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $32.04 | $32.04 | $29.98 | $28,272,741 | $23,370,825 |
| 20 | 2022 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $32.77 | $32.77 | $30.66 | $27,856,850 | $23,134,202 |
| 21 | 2023 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $33.51 | $33.51 | $31.36 | $27,407,528 | $22,864,149 |
| 22 | 2024 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $34.27 | $34.27 | $32.07 | $27,361,831 | $22,926,665 |
| 23 | 2025 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $35.05 | $35.05 | $32.80 | $27,378,120 | $23,038,777 |
| 24 | 2026 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $35.85 | $35.85 | $33.54 | $27,381,059 | $23,137,540 |
| 25 | 2027 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $36.66 | $36.66 | $34.30 | $27,370,036 | $23,222,340 |
| 26 | 2028 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $37.49 | $37.49 | $35.08 | $27,344,415 | $23,292,542 |
| 27 | 2029 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $38.34 | $38.34 | $35.88 | $27,303,538 | $23,347,489 |
| 28 | 2030 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $39.21 | $39.21 | $36.69 | $27,246,728 | $23,386,501 |
| 29 | 2031 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $40.10 | $40.10 | $37.52 | $27,173,281 | $23,408,878 |
| 30 | 2032 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $41.01 | $41.01 | $38.38 | $27,082,473 | $23,413,893 |
| 31 | 2033 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $41.94 | $41.94 | $39.25 | $26,973,552 | $23,400,796 |
| 32 | 2034 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $42.90 | $42.90 | $40.14 | $26,845,744 | $23,368,812 |
| 33 | 2035 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $43.87 | $43.87 | $41.05 | $26,944,774 | $23,532,444 |
| 34 | 2036 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $44.86 | $44.86 | $41.98 | $27,140,266 | $23,779,439 |
| 35 | 2037 | $0 | $0 | $0 | $11,981,935 | $0 | $0 | $0 | $0 | $0 | $0 | $11,981,935 | $45.88 | $45.88 | $42.93 | $0 | $0 |
| 36 | 2038 | $0 | $0 | $0 | $12,253,816 | $0 | $0 | $0 | $0 | $0 | $0 | $12,253,816 | $46.92 | $46.92 | $43.91 | $0 | $0 |
| 37 | 2039 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $47.99 | $47.99 | $44.90 | $0 | $0 |
| 38 | | | | | | | | | | | | | | | | | |
| 39 | **Total:** | $522,948 | $10,197,493 | $0 | $24,235,751 | $32,088,871 | $7,657,299 | $1,871,851 | $0 | $3,137,690 | $47,065,351 | $126,777,255 | | | | $911,782,112 | **$748,245,821** |
| 40 | | | | | | | | | | | | | | | | | |
| 41 | **NPV:** | $367,323 | $7,162,789 | $0 | $371,155 | $20,035,774 | $4,250,013 | $1,168,753 | $0 | $2,203,935 | $33,059,027 | $68,618,769 | | | | $190,080,461 | $133,652,045 |
| 42 | | | | | | | | | | | | | | | | | |
| 43 | **Risked (Mphc = 100%)** | | | | | | | | | | | | | | | | |
| 44 | **Total:** | | $10,197,493 | $0 | $24,235,751 | $32,088,871 | $7,657,299 | $1,871,851 | $0 | $3,137,690 | $47,065,351 | $126,777,255 | | | | $911,782,112 | **$748,245,821** |
| 45 | | | | | | | | | | | | | | | | | |
| 46 | **RNPV:** | $367,323 | $7,162,789 | $0 | $371,155 | $20,035,774 | $4,250,013 | $1,168,753 | $0 | $2,203,935 | $33,059,027 | $68,618,769 | | | | $190,080,461 | **$133,652,045** |
| 47 | | | | | | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | | | | | | |
| 49 | | | | | | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | | | | | | |
| 51 | | | | | | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | | | | | | |
| 53 | | | | | | | | | | | | | | | | | |
| 54 | | | | | | | | | | | | | | | | | |

| R | U | V | W | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH | AI | AJ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ne BFIT ne - Costs) Cumulative | Royalty | Adjusted-1 Revenue (AdjRev1 - Royalty) | Operating Costs | Intangible Investment Costs Wet | Dry | Tangible Investment Costs | Depreciation of Investment | Ad Valorem Property Tax | Taxable Income | State Income Tax | Federal Tax | Net Income After Taxes | After Tax Cash Flow per Year | Cumulative | Year |
| $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | | $0 | $0 | $0 | $0 | $0 | $0 | 2003 |
| $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | 2004 |
| $0 | $0 | $0 | $0 | $11,269,537 | $0 | $49,653,946 | $7,095,549 | $0 | $0 | $0 | $0 | $0 | ($60,923,482) | ($60,923,482) | **2005** |
| $0 | $0 | $0 | $0 | $9,902,091 | $0 | $24,058,631 | $15,598,230 | $0 | $0 | $0 | $0 | $0 | ($33,960,722) | ($94,884,204) | 2006 |
| $36,062,253 | $4,507,782 | $31,554,471 | $11,224,228 | $0 | $0 | $7,657,299 | $15,670,662 | $0 | $15,883,810 | $0 | $5,559,333 | $10,324,476 | $18,337,839 | ($76,546,366) | 2007 |
| $68,027,320 | $3,995,633 | $27,969,434 | $9,661,533 | $0 | $0 | $0 | $12,284,905 | $0 | $15,684,529 | $0 | $5,489,585 | $10,194,944 | $22,479,849 | ($54,066,517) | 2008 |
| $98,241,026 | $3,776,713 | $26,436,992 | $8,870,074 | $0 | $0 | $0 | $8,778,282 | $0 | $17,658,710 | $0 | $6,180,549 | $11,478,162 | $20,256,444 | ($33,810,073) | 2009 |
| $126,901,287 | $3,582,533 | $25,077,728 | $8,174,088 | $0 | $0 | $0 | $7,533,964 | $1,382,409 | $17,543,764 | $0 | $6,140,317 | $11,403,447 | $18,937,411 | ($14,872,662) | 2010 |
| $153,885,897 | $3,373,076 | $23,611,534 | $7,478,101 | $0 | $0 | $0 | $7,263,924 | $2,135,626 | $16,347,610 | $0 | $5,721,663 | $10,625,946 | $17,889,870 | $3,017,208 | 2011 |
| $180,374,425 | $3,311,066 | $23,177,463 | $7,133,891 | $0 | $0 | $0 | $5,046,033 | $2,106,082 | $18,131,430 | $0 | $6,346,000 | $11,785,429 | $16,831,462 | $19,848,670 | 2012 |
| $206,312,088 | $3,242,208 | $22,695,455 | $6,789,967 | $0 | $0 | $0 | $1,756,812 | $2,074,098 | $20,938,643 | $0 | $7,328,525 | $13,610,118 | $15,366,930 | $35,215,600 | 2013 |
| $231,640,966 | $3,166,110 | $22,162,769 | $6,446,043 | $0 | $0 | $0 | $341,516 | $2,039,578 | $21,821,253 | $0 | $7,637,439 | $14,183,814 | $14,525,330 | $49,740,930 | 2014 |
| $256,300,974 | $3,082,501 | $21,577,507 | $6,102,119 | $0 | $0 | $0 | $0 | $2,002,424 | $21,577,507 | $0 | $7,552,127 | $14,025,379 | $14,025,379 | $63,766,309 | 2015 |
| $280,396,268 | $3,011,912 | $21,083,382 | $5,798,257 | $0 | $0 | $0 | $0 | $1,962,533 | $21,083,382 | $0 | $7,379,184 | $13,704,198 | $13,704,198 | $77,470,508 | 2016 |
| $304,403,933 | $3,000,958 | $21,006,707 | $5,618,988 | $0 | $0 | $0 | $0 | $1,919,801 | $21,006,707 | $0 | $7,352,348 | $13,654,360 | $13,654,360 | $91,124,867 | 2017 |
| $328,296,466 | $2,986,567 | $20,905,967 | $5,439,720 | $0 | $0 | $0 | $0 | $1,874,119 | $20,905,967 | $0 | $7,317,088 | $13,588,878 | $13,588,878 | $104,713,746 | 2018 |
| $352,045,253 | $2,968,598 | $20,780,188 | $5,260,452 | $0 | $0 | $0 | $0 | $1,825,376 | $20,780,188 | $0 | $7,273,066 | $13,507,122 | $13,507,122 | $118,220,868 | 2019 |
| $375,620,531 | $2,946,910 | $20,628,369 | $5,081,184 | $0 | $0 | $0 | $0 | $1,773,456 | $20,628,369 | $0 | $7,219,929 | $13,408,440 | $13,408,440 | $131,629,308 | 2020 |
| $398,991,356 | $2,921,353 | $20,449,471 | $4,901,916 | $0 | $0 | $0 | $0 | $1,718,239 | $20,449,471 | $0 | $7,157,315 | $13,292,156 | $13,292,156 | $144,921,464 | 2021 |
| $422,125,558 | $2,891,775 | $20,242,427 | $4,722,648 | $0 | $0 | $0 | $0 | $1,659,604 | $20,242,427 | $0 | $7,084,849 | $13,157,577 | $13,157,577 | $158,079,042 | 2022 |
| $444,989,707 | $2,858,019 | $20,006,130 | $4,543,380 | $0 | $0 | $0 | $0 | $1,597,423 | $20,006,130 | $0 | $7,002,146 | $13,003,985 | $13,003,985 | $171,083,026 | 2023 |
| $467,916,371 | $2,865,833 | $20,060,832 | $4,435,167 | $0 | $0 | $0 | $0 | $1,531,565 | $20,060,832 | $0 | $7,021,291 | $13,039,541 | $13,039,541 | $184,122,567 | 2024 |
| $490,955,148 | $2,879,847 | $20,158,929 | $4,339,343 | $0 | $0 | $0 | $0 | $1,461,897 | $20,158,929 | $0 | $7,055,625 | $13,103,304 | $13,103,304 | $197,225,871 | 2025 |
| $514,092,687 | $2,892,192 | $20,245,347 | $4,243,520 | $0 | $0 | $0 | $0 | $1,388,278 | $20,245,347 | $0 | $7,085,872 | $13,159,476 | $13,159,476 | $210,385,346 | 2026 |
| $537,315,027 | $2,902,792 | $20,319,547 | $4,147,696 | $0 | $0 | $0 | $0 | $1,310,565 | $20,319,547 | $0 | $7,111,842 | $13,207,706 | $13,207,706 | $223,593,052 | 2027 |
| $560,607,569 | $2,911,568 | $20,380,974 | $4,051,873 | $0 | $0 | $0 | $0 | $1,228,611 | $20,380,974 | $0 | $7,133,341 | $13,247,633 | $13,247,633 | $236,840,685 | 2028 |
| $583,955,057 | $2,918,436 | $20,429,052 | $3,956,050 | $0 | $0 | $0 | $0 | $1,142,263 | $20,429,052 | $0 | $7,150,168 | $13,278,884 | $13,278,884 | $250,119,569 | 2029 |
| $607,341,559 | $2,923,313 | $20,463,189 | $3,860,226 | $0 | $0 | $0 | $0 | $1,051,364 | $20,463,189 | $0 | $7,162,116 | $13,301,073 | $13,301,073 | $263,420,642 | 2030 |
| $630,750,437 | $2,926,110 | $20,482,768 | $3,764,403 | $0 | $0 | $0 | $0 | $1,051,364 | $20,482,768 | $0 | $7,168,969 | $13,313,799 | $13,313,799 | $276,734,442 | 2031 |
| $654,164,330 | $2,926,737 | $20,487,157 | $3,668,579 | $0 | $0 | $0 | $0 | $1,051,364 | $20,487,157 | $0 | $7,170,505 | $13,316,652 | $13,316,652 | $290,051,093 | 2032 |
| $677,565,126 | $2,925,100 | $20,475,697 | $3,572,756 | $0 | $0 | $0 | $0 | $1,051,364 | $20,475,697 | $0 | $7,166,494 | $13,309,203 | $13,309,203 | $303,360,296 | 2033 |
| $700,933,938 | $2,921,101 | $20,447,710 | $3,476,933 | $0 | $0 | $0 | $0 | $1,051,364 | $20,447,710 | $0 | $7,156,699 | $13,291,012 | $13,291,012 | $316,651,308 | 2034 |
| $724,466,382 | $2,941,555 | $20,590,888 | $3,412,330 | $0 | $0 | $0 | $0 | $1,051,364 | $20,590,888 | $0 | $7,206,811 | $13,384,078 | $13,384,078 | $330,035,385 | 2035 |
| $748,245,821 | $2,972,430 | $20,807,009 | $3,360,827 | $0 | $0 | $0 | $0 | $1,051,364 | $20,807,009 | $0 | $7,282,453 | $13,524,556 | $13,524,556 | $343,559,941 | 2036 |
| $748,245,821 | $0 | $0 | $0 | $11,981,935 | $0 | $0 | $0 | $1,051,364 | $0 | $0 | $0 | $0 | ($11,981,935) | $331,578,006 | 2037 |
| $748,245,821 | $0 | $0 | $0 | $12,253,816 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | ($12,253,816) | $319,324,190 | 2038 |
| $748,245,821 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $319,324,190 | 2039 |
| | **$93,530,728** | **$654,715,093** | **$163,536,291** | **$45,407,379** | **$0** | **$81,369,876** | **$81,369,876** | **$42,544,862** | **$596,038,996** | **$0** | **$208,613,649** | **$387,425,347** | **$319,324,190** | | |
| | $16,706,506 | $116,945,540 | $35,314,372 | $14,469,662 | $0 | $54,149,107 | $40,905,012 | $6,787,685 | $90,763,774 | $0 | $31,767,321 | $58,996,453 | $16,559,450 | | |
| | **$93,530,728** | **$654,715,093** | **$163,536,291** | **$45,407,379** | **$0** | **$81,369,876** | **$81,369,876** | **$42,544,862** | **$596,038,996** | **$0** | **$208,613,649** | **$387,425,347** | **$319,324,190** | | |
| | **$16,706,506** | **$116,945,540** | **$35,314,372** | **$14,469,662** | **$0** | **$54,149,107** | **$40,905,012** | **$6,787,685** | **$90,763,774** | **$0** | **$31,767,321** | **$58,996,453** | **$16,559,450** | | |

Maximum Negative Cash Flow
($60,923,482)
$60.92

Total Net Cash Flow
$319.32

# Appendix 5: Major Project Costs

## Shows the major costs of this project.

**All in 2004$**

| Norton Exploration Well | |
|---|---|
| **Rig Day Rate (M$/Day)** | $80.00 |
| **Logistical Support (M$/Day)** | $115.00 |
| **Drilling Time (Days)** | 50.00 |
| **Total Drilling Cost (MM$)** | $9.75 |

| Capital Costs | |
|---|---|
| **Total Exp. Drilling Cost (MM$)** | $9.75 |
| **Platform Cost (MM$)** | $30.00 |
| **Dev. Wells (MM$)** | $7.00 |
| **Shore base (MM$)** | $3.00 |
| **$CO_2$ Separation (MM$)** | $4.00 |
| **Production Facility (MM$)** | $16.00 |
| **Total Facilities Capital Cost (MM$)** | $44.00 |

| Production Scenario | | |
|---|---|---|
| **Variable Expenses (MM$)** | $163.54 | **Operating Expenses** |
| **Variable Expenses ($/Mscf)** | $5.00 | |
| **$CO_2$ Separation (MM$)** | $16.35 | |
| **$CO_2$ Separation ($/Mscf)** | $0.50 | |
| **Total Operating Cost** | $179.89 | |
| | | |
| **Transportation Cost (MM$)** | $45.00 | |
| **Transportation Cost ($/Mscf)** | $1.38 | |
| **Transportation Cost ($/Mi)** | $1.13 | |
| **Abandonment (MM$)** | $11.18 | |
| **Abandonment ($/Mscf)** | $0.34 | |
| **Total Production Scenario (MM$)** | $280.06 | |

| | **Cost** | **Percentage** | **Goal** |
|---|---|---|---|
| **Exp.** | $9.75 | 9% | 10% |
| **Plat./Subsea** | $30.00 | 27% | 30% |
| **Production** | $20.00 | 18% | 20% |
| **Dev.** | $7.00 | 6% | 5% |
| **Trans.** | $45.00 | 40% | 35% |
| | | | |
| **Total** | **$111.75** | **100%** | **100%** |
| | | | |
| **Aband.** | $11.18 | 10% | 10% |

# Appendix 6: Ad Valorem (Property) Tax Calculation

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH | AI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AVT Rate:** | **2% (Alaska Statute 43.56)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AVT EOFL:** | **2034 End of assets economic field life** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Inflation Rate:** | **2.27% (input compound inflation assumption)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Inflation Rate (calculated** | **1.000** | **1.023** | **1.046** | **1.070** | **1.094** | **1.119** | **1.144** | **1.170** | **1.197** | **1.224** | **1.252** | **1.280** | **1.309** | **1.339** | **1.369** | **1.400** | **1.432** | **1.464** | **1.498** | **1.532** | **1.566** | **1.602** | **1.638** | **1.675** | **1.713** | **1.752** | **1.792** | **1.833** | **1.874** | **1.917** | **1.960** | **2.005** | **2.050** | **Total** |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Gross Capital Costs** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | |
| **Facilities Tangible ($M)** | **0** | **0** | **0** | **61** | **34** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **95** |
| **Drilling** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Tangible** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Intangible** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total Drill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Depreciation** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** |
| 2002 | 1.0000 | 0.9688 | 0.9375 | 0.9063 | 0.8750 | 0.8438 | 0.8125 | 0.7813 | 0.7500 | 0.7188 | 0.6875 | 0.6563 | 0.6250 | 0.5938 | 0.5625 | 0.5313 | 0.5000 | 0.4688 | 0.4375 | 0.4063 | 0.3750 | 0.3438 | 0.3125 | 0.2813 | 0.2500 | 0.2188 | 0.1875 | 0.1563 | 0.1250 | 0.0938 | 0.0625 | 0.0313 | - | - |
| 2003 | | 1.0000 | 0.9677 | 0.9355 | 0.9032 | 0.8710 | 0.8387 | 0.8065 | 0.7742 | 0.7419 | 0.7097 | 0.6774 | 0.6452 | 0.6129 | 0.5806 | 0.5484 | 0.5161 | 0.4839 | 0.4516 | 0.4194 | 0.3871 | 0.3548 | 0.3226 | 0.2903 | 0.2581 | 0.2258 | 0.1935 | 0.1613 | 0.1290 | 0.0968 | 0.0645 | 0.0323 | - | - |
| 2004 | | | 1.0000 | 0.9667 | 0.9333 | 0.9000 | 0.8667 | 0.8333 | 0.8000 | 0.7667 | 0.7333 | 0.7000 | 0.6667 | 0.6333 | 0.6000 | 0.5667 | 0.5333 | 0.5000 | 0.4667 | 0.4333 | 0.4000 | 0.3667 | 0.3333 | 0.3000 | 0.2667 | 0.2333 | 0.2000 | 0.1667 | 0.1333 | 0.1000 | 0.0667 | 0.0333 | - | - |
| 2005 | | | | 1.0000 | 0.9655 | 0.9310 | 0.8966 | 0.8621 | 0.8276 | 0.7931 | 0.7586 | 0.7241 | 0.6897 | 0.6552 | 0.6207 | 0.5862 | 0.5517 | 0.5172 | 0.4828 | 0.4483 | 0.4138 | 0.3793 | 0.3448 | 0.3103 | 0.2759 | 0.2414 | 0.2069 | 0.1724 | 0.1379 | 0.1034 | 0.0690 | 0.0345 | - | - |
| 2006 | | | | | 1.0000 | 0.9643 | 0.9286 | 0.8929 | 0.8571 | 0.8214 | 0.7857 | 0.7500 | 0.7143 | 0.6786 | 0.6429 | 0.6071 | 0.5714 | 0.5357 | 0.5000 | 0.4643 | 0.4286 | 0.3929 | 0.3571 | 0.3214 | 0.2857 | 0.2500 | 0.2143 | 0.1786 | 0.1429 | 0.1071 | 0.0714 | 0.0357 | - | - |
| 2007 | | | | | | 1.0000 | 0.9630 | 0.9259 | 0.8889 | 0.8519 | 0.8148 | 0.7778 | 0.7407 | 0.7037 | 0.6667 | 0.6296 | 0.5926 | 0.5556 | 0.5185 | 0.4815 | 0.4444 | 0.4074 | 0.3704 | 0.3333 | 0.2963 | 0.2593 | 0.2222 | 0.1852 | 0.1481 | 0.1111 | 0.0741 | 0.0370 | - | - |
| 2008 | | | | | | | 1.0000 | 0.9615 | 0.9231 | 0.8846 | 0.8462 | 0.8077 | 0.7692 | 0.7308 | 0.6923 | 0.6538 | 0.6154 | 0.5769 | 0.5385 | 0.5000 | 0.4615 | 0.4231 | 0.3846 | 0.3462 | 0.3077 | 0.2692 | 0.2308 | 0.1923 | 0.1538 | 0.1154 | 0.0769 | 0.0385 | - | - |
| 2009 | | | | | | | | 1.0000 | 0.9600 | 0.9200 | 0.8800 | 0.8400 | 0.8000 | 0.7600 | 0.7200 | 0.6800 | 0.6400 | 0.6000 | 0.5600 | 0.5200 | 0.4800 | 0.4400 | 0.4000 | 0.3600 | 0.3200 | 0.2800 | 0.2400 | 0.2000 | 0.1600 | 0.1200 | 0.0800 | 0.0400 | - | - |
| 2010 | | | | | | | | | 1.0000 | 0.9583 | 0.9167 | 0.8750 | 0.8333 | 0.7917 | 0.7500 | 0.7083 | 0.6667 | 0.6250 | 0.5833 | 0.5417 | 0.5000 | 0.4583 | 0.4167 | 0.3750 | 0.3333 | 0.2917 | 0.2500 | 0.2083 | 0.1667 | 0.1250 | 0.0833 | 0.0417 | - | - |
| 2011 | | | | | | | | | | 1.0000 | 0.9565 | 0.9130 | 0.8696 | 0.8261 | 0.7826 | 0.7391 | 0.6957 | 0.6522 | 0.6087 | 0.5652 | 0.5217 | 0.4783 | 0.4348 | 0.3913 | 0.3478 | 0.3043 | 0.2609 | 0.2174 | 0.1739 | 0.1304 | 0.0870 | 0.0435 | - | - |
| 2012 | | | | | | | | | | | 1.0000 | 0.9545 | 0.9091 | 0.8636 | 0.8182 | 0.7727 | 0.7273 | 0.6818 | 0.6364 | 0.5909 | 0.5455 | 0.5000 | 0.4545 | 0.4091 | 0.3636 | 0.3182 | 0.2727 | 0.2273 | 0.1818 | 0.1364 | 0.0909 | 0.0455 | - | - |
| 2013 | | | | | | | | | | | | 1.0000 | 0.9524 | 0.9048 | 0.8571 | 0.8095 | 0.7619 | 0.7143 | 0.6667 | 0.6190 | 0.5714 | 0.5238 | 0.4762 | 0.4286 | 0.3810 | 0.3333 | 0.2857 | 0.2381 | 0.1905 | 0.1429 | 0.0952 | 0.0476 | - | - |
| 2014 | | | | | | | | | | | | | 1.0000 | 0.9500 | 0.9000 | 0.8500 | 0.8000 | 0.7500 | 0.7000 | 0.6500 | 0.6000 | 0.5500 | 0.5000 | 0.4500 | 0.4000 | 0.3500 | 0.3000 | 0.2500 | 0.2000 | 0.1500 | 0.1000 | 0.0500 | - | - |
| 2015 | | | | | | | | | | | | | | 1.0000 | 0.9474 | 0.8947 | 0.8421 | 0.7895 | 0.7368 | 0.6842 | 0.6316 | 0.5789 | 0.5263 | 0.4737 | 0.4211 | 0.3684 | 0.3158 | 0.2632 | 0.2105 | 0.1579 | 0.1053 | 0.0526 | - | - |
| 2016 | | | | | | | | | | | | | | | 1.0000 | 0.9444 | 0.8889 | 0.8333 | 0.7778 | 0.7222 | 0.6667 | 0.6111 | 0.5556 | 0.5000 | 0.4444 | 0.3889 | 0.3333 | 0.2778 | 0.2222 | 0.1667 | 0.1111 | 0.0556 | - | - |
| 2017 | | | | | | | | | | | | | | | | 1.0000 | 0.9412 | 0.8824 | 0.8235 | 0.7647 | 0.7059 | 0.6471 | 0.5882 | 0.5294 | 0.4706 | 0.4118 | 0.3529 | 0.2941 | 0.2353 | 0.1765 | 0.1176 | 0.0588 | - | - |
| 2018 | | | | | | | | | | | | | | | | | 1.0000 | 0.9375 | 0.8750 | 0.8125 | 0.7500 | 0.6875 | 0.6250 | 0.5625 | 0.5000 | 0.4375 | 0.3750 | 0.3125 | 0.2500 | 0.1875 | 0.1250 | 0.0625 | - | - |
| 2019 | | | | | | | | | | | | | | | | | | 1.0000 | 0.9333 | 0.8667 | 0.8000 | 0.7333 | 0.6667 | 0.6000 | 0.5333 | 0.4667 | 0.4000 | 0.3333 | 0.2667 | 0.2000 | 0.1333 | 0.0667 | - | - |
| 2020 | | | | | | | | | | | | | | | | | | | 1.0000 | 0.9286 | 0.8571 | 0.7857 | 0.7143 | 0.6429 | 0.5714 | 0.5000 | 0.4286 | 0.3571 | 0.2857 | 0.2143 | 0.1429 | 0.0714 | - | - |
| 2021 | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.9231 | 0.8462 | 0.7692 | 0.6923 | 0.6154 | 0.5385 | 0.4615 | 0.3846 | 0.3077 | 0.2308 | 0.1538 | 0.0769 | - | - |
| 2022 | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.9167 | 0.8333 | 0.7500 | 0.6667 | 0.5833 | 0.5000 | 0.4167 | 0.3333 | 0.2500 | 0.1667 | 0.0833 | - | - |
| 2023 | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.9091 | 0.8182 | 0.7273 | 0.6364 | 0.5455 | 0.4545 | 0.3636 | 0.2727 | 0.1818 | 0.0909 | - | - |
| 2024 | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.9000 | 0.8000 | 0.7000 | 0.6000 | 0.5000 | 0.4000 | 0.3000 | 0.2000 | 0.1000 | - | - |
| 2025 | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.8889 | 0.7778 | 0.6667 | 0.5556 | 0.4444 | 0.3333 | 0.2222 | 0.1111 | - | - |
| 2026 | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.8750 | 0.7500 | 0.6250 | 0.5000 | 0.3750 | 0.2500 | 0.1250 | - | - |
| 2027 | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.8571 | 0.7143 | 0.5714 | 0.4286 | 0.2857 | 0.1429 | - | - |
| 2028 | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.8333 | 0.6667 | 0.5000 | 0.3333 | 0.1667 | - | - |
| 2029 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.8000 | 0.6000 | 0.4000 | 0.2000 | - | - |
| 2030 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.7500 | 0.5000 | 0.2500 | - | - |
| 2031 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.6667 | 0.3333 | - | - |
| 2032 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | 0.5000 | - | - |
| 2033 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 | - | - |
| 2034 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - |
| 2035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - |
| 2036 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2037 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2038 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2039 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2040 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2041 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2042 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2043 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2044 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **AVT by Incremental Capital Investment** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2002 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2003 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2004 | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2005 | | | | 1.38 | 1.37 | 1.35 | 1.33 | 1.30 | 1.28 | 1.25 | 1.23 | 1.20 | 1.17 | 1.13 | 1.10 | 1.06 | 1.02 | 0.98 | 0.93 | 0.89 | 0.84 | 0.79 | 0.73 | 0.67 | 0.61 | 0.55 | 0.48 | 0.41 | 0.33 | 0.26 | 0.17 | 0.09 | 0.00 | |
| 2006 | | | | | 0.77 | 0.76 | 0.75 | 0.74 | 0.72 | 0.71 | 0.69 | 0.68 | 0.66 | 0.64 | 0.62 | 0.60 | 0.58 | 0.55 | 0.53 | 0.50 | 0.47 | 0.44 | 0.41 | 0.38 | 0.34 | 0.31 | 0.27 | 0.23 | 0.19 | 0.14 | 0.10 | 0.05 | 0.00 | |
| 2007 | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2008 | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2009 | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2010 | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2011 | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2012 | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2013 | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2014 | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2015 | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2016 | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2017 | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2018 | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2019 | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2020 | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2021 | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2022 | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2023 | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2024 | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2025 | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2026 | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2027 | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2028 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2029 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2030 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2031 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | |
| 2032 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 0.00 | |
| 2033 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | |
| 2034 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | |
| 2035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2036 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2037 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2038 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2039 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2040 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Year** | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | Total |
| **Gross AVT ($MM)** | 0.00 | 0.00 | 0.00 | 0.00 | 1.38 | 2.14 | 2.11 | 2.07 | 2.04 | 2.00 | 1.96 | 1.92 | 1.87 | 1.83 | 1.77 | 1.72 | 1.66 | 1.60 | 1.53 | 1.46 | 1.39 | 1.31 | 1.23 | 1.14 | 1.05 | 0.96 | 0.86 | 0.75 | 0.64 | 0.52 | 0.40 | 0.27 | 0.14 | 35.19 |

## Appendix 7: Oil and Gas Price Scenario
**Used to calculate and represent past and future hydrocarbon product prices using both the Energy Information Agency and Regression techniques.**

| | | Real Price at West Coast Market | Energy Information Agency Projection | | | | | | Regression Projection | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | Gas Price ($/Mcf) | ANS Oil Price ($/bbl) | ANS Gas Price ($/Mcf) | Norton Diesel Price ($/gal) | Norton Diesel Price ($/bbl) | Norton Imported Gas Price ($/Mcf) | Norton Gas Price ($/Mcf) | West Coast Gas Price ($/Mcf) | Oil Price ($/bbl) | Norton Imported Gas Price ($/Mcf) | Norton Diesel Price ($/gal) | Norton Diesel Price ($/gal) w/ constraint | Norton Gas Price ($/Mcf) |
| 15 | 1949 | $0.21 | | | | | | | | | | | | |
| 16 | 1950 | $0.24 | | | | | | | | | | | | |
| 17 | 1951 | $0.23 | | | | | | | | | | | | |
| 18 | 1952 | $0.26 | | | | | | | | | | | | |
| 19 | 1953 | $0.28 | | | | | | | | | | | | |
| 20 | 1954 | $0.31 | | | | | | | | | | | | |
| 21 | 1955 | $0.30 | | | | | | | | | | | | |
| 22 | 1956 | $0.32 | | | | | | | | | | | | |
| 23 | 1957 | $0.32 | | | | | | | | | | | | |
| 24 | 1958 | $0.34 | | | | | | | | | | | | |
| 25 | 1959 | $0.36 | | | | | | | | | | | | |
| 26 | 1960 | $0.38 | | | | | | | | | | | | |
| 27 | 1961 | $0.39 | | | | | | | | | | | | |
| 28 | 1962 | $0.41 | | | | | | | | | | | | |
| 29 | 1963 | $0.40 | | | | | | | | | | | | |
| 30 | 1964 | $0.37 | | | | | | | | | | | | |
| 31 | 1965 | $0.38 | | | | | | | | | | | | |
| 32 | 1966 | $0.38 | | | | | | | | | | | | |
| 33 | 1967 | $0.37 | | | | | | | | | | | | |
| 34 | 1968 | $0.36 | | | | | | | | | | | | |
| 35 | 1969 | $0.37 | | | | | | | | | | | | |
| 36 | 1970 | $0.36 | | | | | | | | | | | | |
| 37 | 1971 | $0.38 | | | | | | | | | | | | |
| 38 | 1972 | $0.39 | | | | | | | | | | | | |
| 39 | 1973 | $0.44 | | | | | | | | | | | | |
| 40 | 1974 | $0.59 | | | | | | | | | | | | |
| 41 | 1975 | $0.84 | | | | | | | | | | | | |
| 42 | 1976 | $1.09 | | | | | | | | | | | | |
| 43 | 1977 | $1.45 | $11.66 | $1.17 | $0.45 | $18.94 | $4.18 | $8.41 | | | | | | |
| 44 | 1978 | $1.63 | $9.16 | $0.92 | $0.35 | $14.88 | $4.42 | $6.61 | | | | | | |
| 45 | 1979 | $2.07 | $18.14 | $1.81 | $0.70 | $29.48 | $5.26 | $13.09 | | | | | | |
| 46 | 1980 | $2.72 | $28.84 | $2.88 | $1.12 | $46.87 | $5.99 | $20.81 | | | | | | |
| 47 | 1981 | $3.32 | $56.40 | $5.64 | $2.18 | $91.66 | $6.66 | $40.70 | | | | | | |
| 48 | 1982 | $4.03 | $51.80 | $5.18 | $2.00 | $84.19 | $7.44 | $37.38 | | | | | | |
| 49 | 1983 | $4.15 | $46.01 | $4.60 | $1.78 | $74.79 | $7.64 | $33.20 | | | | | | |
| 50 | 1984 | $4.17 | $44.74 | $4.47 | $1.73 | $72.72 | $7.74 | $32.29 | | | | | | |
| 51 | 1985 | $3.84 | $43.99 | $4.40 | $1.70 | $71.50 | $7.50 | $31.75 | | | | | | |
| 52 | 1986 | $2.91 | $20.80 | $2.08 | $0.80 | $33.81 | $6.64 | $15.01 | | | | | | |
| 53 | 1987 | $2.45 | $25.35 | $2.53 | $0.98 | $41.20 | $6.27 | $18.29 | | | | | | |
| 54 | 1988 | $2.42 | $19.35 | $1.94 | $0.75 | $31.45 | $6.33 | $13.96 | | | | | | |
| 55 | 1989 | $2.37 | $23.99 | $2.40 | $0.93 | $38.99 | $6.36 | $17.31 | | | | | | |
| 56 | 1990 | $2.34 | $29.39 | $2.94 | $1.14 | $47.78 | $6.43 | $21.21 | | | | | | |
| 57 | 1991 | $2.20 | $23.04 | $2.30 | $0.89 | $37.45 | $6.37 | $16.63 | | | | | | |
| 58 | 1992 | $2.28 | $22.82 | $2.28 | $0.88 | $37.10 | $6.55 | $16.47 | | | | | | |
| 59 | 1993 | $2.61 | $19.78 | $1.98 | $0.77 | $32.14 | $6.98 | $14.27 | | | | | | |
| 60 | 1994 | $2.32 | $19.03 | $1.90 | $0.74 | $30.92 | $6.78 | $13.73 | | | | | | |
| 61 | 1995 | $1.90 | $20.72 | $2.07 | $0.80 | $33.68 | $6.47 | $14.95 | | | | | | |
| 62 | 1996 | $2.60 | $24.45 | $2.45 | $0.95 | $39.74 | $7.27 | $17.65 | | | | | | |
| 63 | 1997 | $2.71 | $22.21 | $2.22 | $0.86 | $36.10 | $7.50 | $16.03 | | | | | | |
| 64 | 1998 | $2.24 | $14.35 | $1.44 | $0.56 | $23.33 | $7.13 | $10.36 | | | | | | |
| 65 | 1999 | $2.45 | $19.83 | $1.98 | $1.01 | $42.29 | $7.45 | $18.78 | | | | | | |
| 66 | 2000 | $4.04 | $30.93 | $3.09 | $1.19 | $50.08 | $9.15 | $22.23 | | | | | | |
| 67 | 2001 | $4.41 | $24.82 | $2.48 | $1.07 | $44.92 | $9.64 | $19.95 | | | | | | |
| 68 | 2002 | $4.81 | $25.85 | $2.59 | $0.99 | $41.73 | $10.16 | $18.53 | | | | | | |
| 69 | 2003 | $5.62 | $30.31 | $3.03 | $1.05 | $44.24 | $11.09 | $19.64 | | | | | | |
| 70 | 2004 | $6.30 | $38.73 | $3.87 | $1.50 | $62.95 | $11.89 | $27.95 | | | | | | |
| 71 | 2005 | $3.03 | $27.57 | $2.76 | $1.07 | $44.80 | $8.75 | $19.89 | $4.09 | $28.77 | $9.09 | $1.13 | $1.00 | $7.41 |
| 72 | 2006 | $3.10 | $28.19 | $2.82 | $1.09 | $45.82 | $8.95 | $20.34 | $4.17 | $29.28 | $9.17 | $1.15 | $1.02 | $7.56 |
| 73 | 2007 | $3.17 | $28.83 | $2.88 | $1.12 | $46.86 | $9.15 | $20.81 | $4.25 | $29.80 | $9.25 | $1.18 | $1.04 | $7.72 |
| 74 | 2008 | $3.24 | $29.49 | $2.95 | $1.14 | $47.92 | $9.36 | $21.28 | $4.33 | $30.32 | $9.33 | $1.20 | $1.06 | $7.87 |
| 75 | 2009 | $3.32 | $30.15 | $3.02 | $1.17 | $49.01 | $9.57 | $21.76 | $4.42 | $30.84 | $9.42 | $1.22 | $1.08 | $8.03 |
| 76 | 2010 | $3.39 | $30.84 | $3.08 | $1.19 | $50.12 | $9.79 | $22.25 | $4.50 | $31.36 | $9.50 | $1.24 | $1.10 | $8.18 |
| 77 | 2011 | $3.47 | $31.54 | $3.15 | $1.22 | $51.26 | $10.01 | $22.76 | $4.58 | $31.88 | $9.58 | $1.26 | $1.13 | $8.34 |
| 78 | 2012 | $3.55 | $32.25 | $3.23 | $1.25 | $52.42 | $10.24 | $23.28 | $4.66 | $32.40 | $9.66 | $1.28 | $1.15 | $8.50 |
| 79 | 2013 | $3.63 | $32.99 | $3.30 | $1.28 | $53.61 | $10.47 | $23.80 | $4.75 | $32.92 | $9.75 | $1.30 | $1.17 | $8.65 |
| 80 | 2014 | $3.71 | $33.73 | $3.37 | $1.31 | $54.83 | $10.71 | $24.34 | $4.83 | $33.43 | $9.83 | $1.32 | $1.19 | $8.81 |
| 81 | 2015 | $3.79 | $34.50 | $3.45 | $1.34 | $56.07 | $10.95 | $24.90 | $4.91 | $33.95 | $9.91 | $1.34 | $1.21 | $8.96 |
| 82 | 2016 | $3.88 | $35.28 | $3.53 | $1.37 | $57.35 | $11.20 | $25.46 | $4.99 | $34.47 | $9.99 | $1.36 | $1.23 | $9.12 |
| 83 | 2017 | $3.97 | $36.08 | $3.61 | $1.40 | $58.65 | $11.46 | $26.04 | $5.08 | $34.99 | $10.08 | $1.39 | $1.25 | $9.27 |
| 84 | 2018 | $4.06 | $36.90 | $3.69 | $1.43 | $59.98 | $11.72 | $26.63 | $5.16 | $35.51 | $10.16 | $1.41 | $1.27 | $9.43 |
| 85 | 2019 | $4.15 | $37.74 | $3.77 | $1.46 | $61.34 | $11.98 | $27.23 | $5.24 | $36.03 | $10.24 | $1.43 | $1.29 | $9.58 |
| 86 | 2020 | $4.24 | $38.60 | $3.86 | $1.49 | $62.73 | $12.25 | $27.85 | $5.32 | $36.55 | $10.32 | $1.45 | $1.31 | $9.74 |
| 87 | 2021 | $4.34 | $39.47 | $3.95 | $1.53 | $64.15 | $12.53 | $28.48 | $5.40 | $37.07 | $10.40 | $1.47 | $1.34 | $9.89 |
| 88 | 2022 | $4.44 | $40.37 | $4.04 | $1.56 | $65.61 | $12.82 | $29.13 | $5.49 | $37.59 | $10.49 | $1.49 | $1.36 | $10.05 |
| 89 | 2023 | $4.54 | $41.28 | $4.13 | $1.60 | $67.10 | $13.11 | $29.79 | $5.57 | $38.10 | $10.57 | $1.51 | $1.38 | $10.20 |
| 90 | 2024 | $4.64 | $42.22 | $4.22 | $1.63 | $68.62 | $13.40 | $30.47 | $5.65 | $38.62 | $10.65 | $1.53 | $1.40 | $10.36 |
| 91 | 2025 | $4.75 | $43.18 | $4.32 | $1.67 | $70.18 | $13.71 | $31.16 | $5.73 | $39.14 | $10.73 | $1.55 | $1.42 | $10.51 |
| 92 | 2026 | $4.86 | $44.16 | $4.42 | $1.71 | $71.77 | $14.02 | $31.87 | $5.82 | $39.66 | $10.82 | $1.57 | $1.44 | $10.67 |
| 93 | 2027 | $4.97 | $45.16 | $4.52 | $1.75 | $73.40 | $14.34 | $32.59 | $5.90 | $40.18 | $10.90 | $1.60 | $1.46 | $10.83 |
| 94 | 2028 | $5.08 | $46.18 | $4.62 | $1.79 | $75.06 | $14.66 | $33.33 | $5.98 | $40.70 | $10.98 | $1.62 | $1.48 | $10.98 |
| 95 | 2029 | $5.19 | $47.23 | $4.72 | $1.83 | $76.77 | $15.00 | $34.08 | $6.06 | $41.22 | $11.06 | $1.64 | $1.50 | $11.14 |
| 96 | 2030 | $5.31 | $48.30 | $4.83 | $1.87 | $78.51 | $15.34 | $34.86 | $6.15 | $41.74 | $11.15 | $1.66 | $1.52 | $11.29 |
| 97 | 2031 | $5.43 | $49.40 | $4.94 | $1.91 | $80.29 | $15.68 | $35.65 | $6.23 | $42.25 | $11.23 | $1.68 | $1.55 | $11.45 |
| 98 | 2032 | $5.56 | $50.52 | $5.05 | $1.96 | $82.11 | $16.04 | $36.46 | $6.31 | $42.77 | $11.31 | $1.70 | $1.57 | $11.60 |
| 99 | 2033 | $5.68 | $51.67 | $5.17 | $2.00 | $83.98 | $16.40 | $37.28 | $6.39 | $43.29 | $11.39 | $1.72 | $1.59 | $11.76 |
| 100 | 2034 | $5.81 | $52.84 | $5.28 | $2.04 | $85.88 | $16.78 | $38.13 | $6.48 | $43.81 | $11.48 | $1.74 | $1.61 | $11.91 |
| 101 | 2035 | $5.94 | $54.04 | $5.40 | $2.09 | $87.83 | $17.16 | $39.00 | $6.56 | $44.33 | $11.56 | $1.76 | $1.63 | $12.07 |
| 102 | 2036 | $6.08 | $55.27 | $5.53 | $2.14 | $89.82 | $17.55 | $39.88 | $6.64 | $44.85 | $11.64 | $1.78 | $1.65 | $12.22 |
| 103 | 2037 | $6.22 | $56.52 | $5.65 | $2.19 | $91.86 | $17.94 | $40.79 | $6.72 | $45.37 | $11.72 | $1.81 | $1.67 | $12.38 |
| 104 | 2038 | $6.36 | $57.80 | $5.78 | $2.24 | $93.95 | $18.35 | $41.71 | $6.80 | $45.89 | $11.80 | $1.83 | $1.69 | $12.53 |
| 105 | 2039 | $6.50 | $59.11 | $5.91 | $2.29 | $96.08 | $18.77 | $42.66 | $6.89 | $46.41 | $11.89 | $1.85 | $1.71 | $12.69 |
| 106 | 2040 | $6.65 | $60.45 | $6.05 | $2.34 | $98.26 | $19.19 | $43.63 | $6.97 | $46.92 | $11.97 | $1.87 | $1.73 | $12.85 |
| 107 | 2041 | $6.80 | $61.83 | $6.18 | $2.39 | $100.49 | $19.63 | $44.61 | $7.05 | $47.44 | $12.05 | $1.89 | $1.76 | $13.00 |
| 108 | 2042 | $6.95 | $63.23 | $6.32 | $2.45 | $102.77 | $20.07 | $45.63 | $7.13 | $47.96 | $12.13 | $1.91 | $1.78 | $13.16 |
| 109 | 2043 | $7.11 | $64.66 | $6.47 | $2.50 | $105.10 | $20.53 | $46.66 | $7.22 | $48.48 | $12.22 | $1.93 | $1.80 | $13.31 |
| 110 | 2044 | $7.27 | $66.13 | $6.61 | $2.56 | $107.48 | $21.00 | $47.72 | $7.30 | $49.00 | $12.30 | $1.95 | $1.82 | $13.47 |
| 111 | 2045 | $7.44 | $67.63 | $6.76 | $2.62 | $109.92 | $21.47 | $48.80 | $7.38 | $49.52 | $12.38 | $1.97 | $1.84 | $13.62 |
| 112 | 2046 | $7.61 | $69.17 | $6.92 | $2.68 | $112.42 | $21.96 | $49.91 | $7.46 | $50.04 | $12.46 | $1.99 | $1.86 | $13.78 |
| 113 | 2047 | $7.78 | $70.74 | $7.07 | $2.74 | $114.97 | $22.46 | $51.04 | $7.55 | $50.56 | $12.55 | $2.01 | $1.88 | $13.93 |
| 114 | 2048 | $7.96 | $72.34 | $7.23 | $2.80 | $117.58 | $22.97 | $52.20 | $7.63 | $51.07 | $12.63 | $2.04 | $1.90 | $14.09 |
| 115 | 2049 | $8.14 | $73.98 | $7.40 | $2.86 | $120.24 | $23.49 | $53.39 | $7.71 | $51.59 | $12.71 | $2.06 | $1.92 | $14.24 |
| 116 | 2050 | $8.32 | $75.66 | $7.57 | $2.93 | $122.97 | $24.02 | $54.60 | $7.79 | $52.11 | $12.79 | $2.08 | $1.94 | $14.40 |
| 117 | 2051 | $8.51 | $77.38 | $7.74 | $2.99 | $125.76 | $24.57 | $55.84 | $7.88 | $52.63 | $12.88 | $2.10 | $1.96 | $14.55 |
| 118 | 2052 | $8.70 | $79.13 | $7.91 | $3.06 | $128.62 | $25.12 | $57.10 | $7.96 | $53.15 | $12.96 | $2.12 | $1.99 | $14.71 |
| 119 | 2053 | $8.90 | $80.93 | $8.09 | $3.13 | $131.54 | $25.69 | $58.40 | $8.04 | $53.67 | $13.04 | $2.14 | $2.01 | $14.87 |
| 120 | 2054 | $9.10 | $82.77 | $8.28 | $3.20 | $134.52 | $26.28 | $59.73 | $8.12 | $54.19 | $13.12 | $2.16 | $2.03 | $15.02 |
| 121 | 2055 | $9.31 | $84.64 | $8.46 | $3.28 | $137.57 | $26.87 | $61.08 | $8.21 | $54.71 | $13.21 | $2.18 | $2.05 | $15.18 |
| 122 | 2056 | $9.52 | $86.56 | $8.66 | $3.35 | $140.69 | $27.48 | $62.47 | $8.29 | $55.23 | $13.29 | $2.20 | $2.07 | $15.33 |
| 123 | 2057 | $9.74 | $88.53 | $8.85 | $3.43 | $143.89 | $28.11 | $63.88 | $8.37 | $55.74 | $13.37 | $2.22 | $2.09 | $15.49 |
| 124 | 2058 | $9.96 | $90.54 | $9.05 | $3.50 | $147.15 | $28.75 | $65.33 | $8.45 | $56.26 | $13.45 | $2.25 | $2.11 | $15.64 |
| 125 | 2059 | $10.18 | $92.59 | $9.26 | $3.58 | $150.49 | $29.40 | $66.82 | $8.53 | $56.78 | $13.53 | $2.27 | $2.13 | $15.80 |
| 126 | 2060 | $10.41 | $94.69 | $9.47 | $3.66 | $153.91 | $30.06 | $68.33 | $8.62 | $57.30 | $13.62 | $2.29 | $2.15 | $15.95 |
| 127 | 2061 | $10.65 | $96.84 | $9.68 | $3.75 | $157.40 | $30.75 | $69.88 | $8.70 | $57.82 | $13.70 | $2.31 | $2.17 | $16.11 |
| 128 | 2062 | $10.89 | $99.04 | $9.90 | $3.83 | $160.97 | $31.44 | $71.47 | $8.78 | $58.34 | $13.78 | $2.33 | $2.20 | $16.26 |
| 129 | 2063 | $11.14 | $101.29 | $10.13 | $3.92 | $164.62 | $32.16 | $73.09 | $8.86 | $58.86 | $13.86 | $2.35 | $2.22 | $16.42 |

## Appendix 8: Price History

**Represents the Alaska oil prices and is used to calculate equivalent energy prices in a BTU and KWh basis.**

| Oil Market ($/bbl) | | ANS West Coast | ANS Gulf Coast | ANS Market | Oil Market ($/bbl) | | ANS West Coast | ANS Gulf Coast | ANS Market | Oil Market ($/bbl) | | ANS West Coast |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | Jan | m | $35.94 | $35.94 | 1991 | Jan | $20.57 | $21.20 | $20.77 | 2001 | Jan | $24.37 |
| | Feb | m | $35.94 | $35.94 | | Feb | $15.74 | $16.08 | $15.82 | | Feb | $26.02 |
| | Mar | m | $35.94 | $35.94 | | Mar | $17.02 | $17.71 | $17.18 | | Mar | $24.70 |
| | Apr | m | $34.75 | $34.75 | | Apr | $17.56 | $18.16 | $17.68 | | Apr | $25.55 |
| | May | m | $32.05 | $32.05 | | May | $16.67 | $18.01 | $16.97 | | May | $26.70 |
| | Jun | m | $31.50 | $31.50 | | Jun | $16.36 | $17.58 | $16.63 | | Jun | $25.79 |
| | Jul | m | $32.50 | $32.50 | | Jul | $17.25 | $18.30 | $17.41 | | Jul | $24.60 |
| | Aug | m | $33.00 | $33.00 | | Aug | $17.18 | $18.49 | $17.45 | | Aug | $24.12 |
| | Sep | m | $32.10 | $32.10 | | Sep | $17.31 | $19.05 | $17.68 | | Sep | $23.17 |
| | Oct | m | $33.19 | $33.19 | | Oct | $18.47 | $20.05 | $18.81 | | Oct | $19.50 |
| | Nov | m | $33.75 | $33.75 | | Nov | $17.57 | $19.16 | $17.94 | | Nov | $17.23 |
| | Dec | m | $33.29 | $33.29 | | Dec | $14.83 | $16.44 | $15.15 | | Dec | $16.73 |
| | Yearly Averages | m | $33.66 | $33.66 | | Yearly Averages | $17.21 | $18.35 | $17.46 | | Yearly Averages | $23.21 |
| 1982 | Jan | m | $33.20 | $33.20 | 1992 | Jan | $14.92 | $15.74 | $15.10 | 2002 | Jan | $17.52 |
| | Feb | m | $30.15 | $30.15 | | Feb | $15.30 | $16.17 | $15.52 | | Feb | $19.14 |
| | Mar | m | $28.25 | $28.25 | | Mar | $15.50 | $16.29 | $15.68 | | Mar | $22.73 |
| | Apr | m | $30.83 | $30.83 | | Apr | $16.96 | $17.77 | $17.13 | | Apr | $24.99 |
| | May | m | $32.76 | $32.76 | | May | $18.03 | $18.62 | $18.13 | | May | $25.87 |
| | Jun | m | $33.09 | $33.09 | | Jun | $20.20 | $20.56 | $20.25 | | Jun | $24.16 |
| | Jul | m | $32.72 | $32.72 | | Jul | $19.40 | $19.65 | $19.43 | | Jul | $25.82 |
| | Aug | m | $31.56 | $31.56 | | Aug | $17.97 | $18.82 | $18.08 | | Aug | $27.39 |
| | Sep | m | $33.04 | $33.04 | | Sep | $18.46 | $19.31 | $18.59 | | Sep | $28.73 |
| | Oct | m | $32.99 | $32.99 | | Oct | $18.71 | $19.43 | $18.82 | | Oct | $27.53 |
| | Nov | m | $31.86 | $31.86 | | Nov | $17.46 | $18.26 | $17.58 | | Nov | $24.69 |
| | Dec | m | $28.98 | $28.98 | | Dec | $16.33 | $17.19 | $16.52 | | Dec | $28.03 |
| | Yearly Averages | m | $31.62 | $31.62 | | Yearly Averages | $17.44 | $18.15 | $17.57 | | Yearly Averages | $24.72 |
| 1983 | Jan | m | $28.18 | $28.18 | 1993 | Jan | $15.62 | $16.59 | $15.82 | 2003 | Jan | $31.97 |
| | Feb | m | $27.06 | $27.06 | | Feb | $16.78 | $17.90 | $16.91 | | Feb | $35.20 |
| | Mar | m | $27.00 | $27.00 | | Mar | $17.35 | $18.34 | $17.49 | | Mar | $32.59 |
| | Apr | m | $28.68 | $28.68 | | Apr | $18.17 | $18.30 | $18.19 | | Apr | $25.59 |
| | May | m | $28.60 | $28.60 | | May | $17.47 | $17.99 | $17.52 | | May | $26.19 |
| | Jun | m | $29.65 | $29.65 | | Jun | $16.02 | $17.02 | $16.12 | | Jun | $29.35 |
| | Jul | m | $29.98 | $29.98 | | Jul | $14.84 | $15.89 | $14.95 | | Jul | $29.17 |
| | Aug | m | $30.29 | $30.29 | | Aug | $15.42 | $16.21 | $15.50 | | Aug | $30.22 |
| | Sep | m | $29.56 | $29.56 | | Sep | $14.98 | $15.51 | $15.06 | | Sep | $27.09 |
| | Oct | m | $28.55 | $28.55 | | Oct | $15.39 | $16.02 | $15.49 | | Oct | $28.55 |
| | Nov | m | $29.05 | $29.05 | | Nov | $13.07 | $14.32 | $13.32 | | Nov | $29.10 |
| | Dec | m | $28.09 | $28.09 | | Dec | $10.29 | $12.28 | $10.77 | | Dec | $30.68 |
| | Yearly Averages | m | $28.72 | $28.72 | | Yearly Averages | $15.45 | $16.36 | $15.60 | | Yearly Averages | $29.64 |
| 1984 | Jan | m | $28.48 | $28.48 | 1994 | Jan | $11.66 | $13.28 | $12.01 | 2004 | Jan | $33.10 |
| | Feb | m | $28.95 | $28.95 | | Feb | $12.59 | $13.75 | $12.81 | | Feb | $33.65 |
| | Mar | m | $29.66 | $29.66 | | Mar | $12.91 | $13.70 | $13.12 | | Mar | $35.51 |
| | Apr | m | $29.49 | $29.49 | | Apr | $14.96 | $15.54 | $15.03 | | Apr | $35.43 |
| | May | m | $29.37 | $29.37 | | May | $16.47 | $16.81 | $16.52 | | May | $39.07 |
| | Jun | m | $29.28 | $29.28 | | Jun | $16.43 | $16.93 | $16.51 | | Jun | $36.73 |
| | Jul | m | $28.35 | $28.35 | | Jul | $16.52 | $17.47 | $16.67 | | Jul | $39.44 |
| | Aug | m | $28.59 | $28.59 | | Aug | $16.66 | $16.88 | $16.69 | | Aug | $43.12 |
| | Sep | m | $28.54 | $28.54 | | Sep | $16.11 | $16.00 | $16.09 | | Sep | $42.71 |
| | Oct | m | $28.01 | $28.01 | | Oct | $16.02 | $15.90 | $16.00 | | Oct | $48.56 |
| | Nov | m | $27.56 | $27.56 | | Nov | $16.71 | $16.81 | $16.73 | | Nov | |
| | Dec | m | $26.48 | $26.48 | | Dec | $15.38 | $15.95 | $15.50 | | Dec | |
| | Yearly Averages | m | $28.56 | $28.56 | | Yearly Averages | $15.20 | $15.75 | $15.31 | | Yearly Averages | $38.73 |
| 1985 | Jan | m | $26.03 | $26.03 | 1995 | Jan | $16.16 | $16.86 | $16.33 | 2005 | Jan | |
| | Feb | m | $28.04 | $28.04 | | Feb | $17.14 | $17.42 | $17.19 | | Feb | |
| | Mar | m | $28.61 | $28.61 | | Mar | $17.31 | $17.40 | $17.32 | | Mar | |
| | Apr | m | $28.39 | $28.39 | | Apr | $18.36 | $18.81 | $18.41 | | Apr | |
| | May | m | $26.77 | $26.77 | | May | $18.43 | $18.76 | $18.50 | | May | |
| | Jun | m | $25.81 | $25.81 | | Jun | $17.43 | $17.34 | $17.42 | | Jun | |
| | Jul | m | $26.32 | $26.32 | | Jul | $16.23 | $16.25 | $16.23 | | Jul | |
| | Aug | m | $27.15 | $27.15 | | Aug | $16.72 | $16.82 | $16.73 | | Aug | |
| | Sep | m | $27.33 | $27.33 | | Sep | $16.65 | $16.67 | $16.65 | | Sep | |
| | Oct | m | $27.37 | $27.37 | | Oct | $15.96 | $15.91 | $15.95 | | Oct | |
| | Nov | m | $28.84 | $28.84 | | Nov | $15.88 | $16.51 | $15.99 | | Nov | |
| | Dec | m | $25.61 | $25.61 | | Dec | $16.94 | $17.59 | $17.04 | | Dec | |
| | Yearly Averages | m | $28.72 | $28.72 | | Yearly Averages | $16.93 | $17.20 | $16.98 | | Yearly Averages | |
| 1986 | Jan | m | $22.25 | $22.25 | 1996 | Jan | $17.23 | $17.60 | $17.26 | 2006 | Jan | |
| | Feb | m | $14.81 | $14.81 | | Feb | $17.78 | $17.98 | $17.81 | | Feb | |
| | Mar | m | $12.46 | $12.46 | | Mar | $20.40 | $20.25 | $20.39 | | Mar | |
| | Apr | m | $12.35 | $12.35 | | Apr | $22.04 | $22.16 | $22.05 | | Apr | |
| | May | m | $14.04 | $14.04 | | May | $19.65 | m | m | | May | |
| | Jun | m | $11.72 | $11.72 | | Jun | $18.98 | m | m | | Jun | |
| | Jul | m | $9.72 | $9.72 | | Jul | $19.79 | m | m | | Jul | |
| | Aug | m | $13.32 | $13.32 | | Aug | $19.90 | m | m | | Aug | |
| | Sep | m | $13.45 | $13.45 | | Sep | $21.69 | m | m | | Sep | |
| | Oct | m | $13.43 | $13.43 | | Oct | $22.60 | m | m | | Oct | |
| | Nov | m | $13.96 | $13.96 | | Nov | $21.50 | m | m | | Nov | |
| | Dec | m | $15.16 | $15.16 | | Dec | $23.66 | m | m | | Dec | |
| | Yearly Averages | m | $13.89 | $13.89 | | Yearly Averages | $20.44 | m | m | | Yearly Averages | |
| 1987 | Jan | m | $18.11 | $18.11 | 1997 | Jan | $23.57 | m | m | 2007 | Jan | |
| | Feb | m | $17.10 | $17.10 | | Feb | $21.03 | m | m | | Feb | |
| | Mar | m | $17.74 | $17.74 | | Mar | $20.07 | m | m | | Mar | |
| | Apr | m | $18.07 | $18.07 | | Apr | $18.54 | m | m | | Apr | |
| | May | $17.28 | $18.80 | $17.99 | | May | $19.41 | m | m | | May | |
| | Jun | $17.85 | $19.05 | $18.33 | | Jun | $17.30 | m | m | | Jun | |
| | Jul | $19.20 | $20.09 | $19.57 | | Jul | $17.48 | m | m | | Jul | |
| | Aug | $18.52 | $18.93 | $18.68 | | Aug | $17.98 | m | m | | Aug | |
| | Sep | $17.46 | $18.28 | $17.77 | | Sep | $18.09 | m | m | | Sep | |
| | Oct | $17.41 | $18.62 | $17.86 | | Oct | $19.59 | m | m | | Oct | |
| | Nov | $16.36 | $17.18 | $16.72 | | Nov | $18.33 | m | m | | Nov | |
| | Dec | $14.39 | $15.38 | $14.77 | | Dec | $16.39 | m | m | | Dec | |
| | Yearly Averages | $17.31 | $18.11 | $17.73 | | Yearly Averages | $18.98 | m | m | | Yearly Averages | |
| 1988 | Jan | $14.23 | $15.59 | $14.80 | 1998 | Jan | $14.79 | m | m | 2008 | Jan | |
| | Feb | $14.03 | $14.99 | $14.43 | | Feb | $13.39 | m | m | | Feb | |
| | Mar | $13.79 | $14.31 | $13.99 | | Mar | $12.25 | m | m | | Mar | |
| | Apr | $15.29 | $15.73 | $15.44 | | Apr | $12.41 | m | m | | Apr | |
| | May | $14.86 | $15.46 | $15.07 | | May | $12.31 | m | m | | May | |
| | Jun | $14.14 | $14.81 | $14.37 | | Jun | $11.62 | m | m | | Jun | |
| | Jul | $13.70 | $14.31 | $13.88 | | Jul | $12.92 | m | m | | Jul | |
| | Aug | $13.63 | $14.11 | $13.77 | | Aug | $12.49 | m | m | | Aug | |
| | Sep | $12.58 | $12.94 | $12.69 | | Sep | $14.13 | m | m | | Sep | |
| | Oct | $11.34 | $11.78 | $11.49 | | Oct | $13.38 | m | m | | Oct | |
| | Nov | $11.36 | $11.68 | $11.47 | | Nov | $11.47 | m | m | | Nov | |
| | Dec | $13.23 | $14.36 | $13.59 | | Dec | $9.39 | m | m | | Dec | |
| | Yearly Averages | $13.52 | $14.17 | $13.75 | | Yearly Averages | $12.55 | m | m | | Yearly Averages | |
| 1989 | Jan | $15.11 | $16.33 | $15.46 | 1999 | Jan | $10.69 | m | m | 2009 | Jan | |
| | Feb | $15.99 | $16.48 | $16.15 | | Feb | $10.43 | m | m | | Feb | |
| | Mar | $17.25 | $17.75 | $17.38 | | Mar | $13.07 | m | m | | Mar | |
| | Apr | $19.37 | $19.97 | $19.55 | | Apr | $15.64 | m | m | | Apr | |
| | May | $17.64 | $18.01 | $17.75 | | May | $15.86 | m | m | | May | |
| | Jun | $17.00 | $17.43 | $17.14 | | Jun | $15.82 | m | m | | Jun | |
| | Jul | $16.78 | $17.21 | $16.89 | | Jul | $18.16 | m | m | | Jul | |
| | Aug | $16.04 | $16.48 | $16.17 | | Aug | $20.08 | m | m | | Aug | |
| | Sep | $16.62 | $17.07 | $16.74 | | Sep | $22.96 | m | m | | Sep | |
| | Oct | $17.27 | $17.80 | $17.42 | | Oct | $21.83 | m | m | | Oct | |
| | Nov | $17.49 | $18.04 | $17.63 | | Nov | $23.65 | m | m | | Nov | |
| | Dec | $19.07 | $19.52 | $19.19 | | Dec | $24.54 | m | m | | Dec | |
| | Yearly Averages | $17.14 | $17.67 | $17.29 | | Yearly Averages | $17.73 | m | m | | Yearly Averages | |
| 1990 | Jan | $20.00 | $20.22 | $20.05 | 2000 | Jan | $25.74 | m | m | 2010 | Jan | |
| | Feb | $19.30 | $19.77 | $19.41 | | Feb | $27.65 | m | m | | Feb | |
| | Mar | $17.91 | $18.34 | $18.01 | | Mar | $28.01 | m | m | | Mar | |
| | Apr | $14.82 | $15.19 | $14.91 | | Apr | $23.83 | m | m | | Apr | |
| | May | $14.38 | $14.86 | $14.50 | | May | $27.15 | m | m | | May | |
| | Jun | $13.20 | $13.68 | $13.29 | | Jun | $29.62 | m | m | | Jun | |
| | Jul | $15.55 | $16.03 | $15.64 | | Jul | $27.63 | m | m | | Jul | |
| | Aug | $25.99 | $26.40 | $26.07 | | Aug | $29.40 | m | m | | Aug | |
| | Sep | $32.16 | $32.53 | $32.23 | | Sep | $32.25 | m | m | | Sep | |
| | Oct | $31.53 | $32.06 | $31.66 | | Oct | $31.56 | m | m | | Oct | |
| | Nov | $28.79 | $29.64 | $29.00 | | Nov | $32.74 | m | m | | Nov | |
| | Dec | $24.02 | $25.01 | $24.31 | | Dec | $23.72 | m | m | | Dec | |
| | Yearly Averages | $21.47 | $21.98 | $21.59 | | Yearly Averages | $28.28 | m | m | | Yearly Averages | |

| Market Prices | Nominal Gas ($/Mcf) | Real Gas ($/Mcf) | Nominal ANS Oil ($/bbl) | Real ANS Oil ($/bbl) | W. Coast Market Real Gas ($/MBTU) | W. Coast Real ANS Oil ($/MBTU) | W. Coast Gas Imported into Norton (2004$/MBTU) | No. 2 Diesel Fuel in Norton (2004$/MBTU) | Norton Diesel Converted Gas (2004$/MBTU) | W. Coast Market Real Gas ($/KWh) | W. Coast Real ANS Oil ($/KWh) | W. Coast Gas Imported into Norton ($/KWh) | No. 2 Diesel Fuel in Norton ($/KWh) | Norton Diesel Converted Gas ($/KWh) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1949 | $0.06 | $0.21 | m | m | $0.00021 | m | m | m | m | $0.00070 | m | m | m | m |
| 1950 | $0.07 | $0.24 | m | m | $0.00024 | m | m | m | m | $0.00080 | m | m | m | m |
| 1951 | $0.07 | $0.23 | m | m | $0.00023 | m | m | m | m | $0.00078 | m | m | m | m |
| 1952 | $0.08 | $0.26 | m | m | $0.00026 | m | m | m | m | $0.00087 | m | m | m | m |
| 1953 | $0.09 | $0.28 | m | m | $0.00028 | m | m | m | m | $0.00096 | m | m | m | m |
| 1954 | $0.10 | $0.31 | m | m | $0.00031 | m | m | m | m | $0.00104 | m | m | m | m |
| 1955 | $0.10 | $0.30 | m | m | $0.00030 | m | m | m | m | $0.00102 | m | m | m | m |
| 1956 | $0.11 | $0.32 | m | m | $0.00032 | m | m | m | m | $0.00110 | m | m | m | m |
| 1957 | $0.11 | $0.32 | m | m | $0.00032 | m | m | m | m | $0.00107 | m | m | m | m |
| 1958 | $0.12 | $0.34 | m | m | $0.00034 | m | m | m | m | $0.00114 | m | m | m | m |
| 1959 | $0.13 | $0.36 | m | m | $0.00036 | m | m | m | m | $0.00121 | m | m | m | m |
| 1960 | $0.14 | $0.38 | m | m | $0.00038 | m | m | m | m | $0.00128 | m | m | m | m |
| 1961 | $0.15 | $0.39 | m | m | $0.00039 | m | m | m | m | $0.00134 | m | m | m | m |
| 1962 | $0.16 | $0.41 | m | m | $0.00041 | m | m | m | m | $0.00139 | m | m | m | m |
| 1963 | $0.16 | $0.40 | m | m | $0.00040 | m | m | m | m | $0.00136 | m | m | m | m |
| 1964 | $0.15 | $0.37 | m | m | $0.00037 | m | m | m | m | $0.00125 | m | m | m | m |
| 1965 | $0.16 | $0.38 | m | m | $0.00038 | m | m | m | m | $0.00130 | m | m | m | m |
| 1966 | $0.16 | $0.38 | m | m | $0.00038 | m | m | m | m | $0.00127 | m | m | m | m |
| 1967 | $0.16 | $0.37 | m | m | $0.00037 | m | m | m | m | $0.00125 | m | m | m | m |
| 1968 | $0.16 | $0.36 | m | m | $0.00036 | m | m | m | m | $0.00122 | m | m | m | m |
| 1969 | $0.17 | $0.37 | m | m | $0.00037 | m | m | m | m | $0.00127 | m | m | m | m |
| 1970 | $0.17 | $0.36 | m | m | $0.00036 | m | m | m | m | $0.00124 | m | m | m | m |
| 1971 | $0.18 | $0.38 | m | m | $0.00038 | m | m | m | m | $0.00128 | m | m | m | m |
| 1972 | $0.19 | $0.39 | m | m | $0.00039 | m | m | m | m | $0.00132 | m | m | m | m |
| 1973 | $0.22 | $0.44 | m | m | $0.00044 | m | m | m | m | $0.00150 | m | m | m | m |
| 1974 | $0.30 | $0.59 | m | m | $0.00059 | m | m | m | m | $0.00200 | m | m | m | m |
| 1975 | $0.44 | $0.84 | m | m | $0.00084 | m | m | m | m | $0.00286 | m | m | m | m |
| 1976 | $0.58 | $1.09 | m | m | $0.00109 | m | m | m | m | $0.00369 | m | m | m | m |
| 1977 | $0.79 | $1.45 | $6.36 | $11.66 | $0.0014 | $0.0020 | $0.0042 | $0.0033 | $0.0084 | $0.0049 | $0.0002 | $0.0142 | $0.0114 | $0.0285 |
| 1978 | $0.91 | $1.63 | $5.11 | $9.16 | $0.0016 | $0.0016 | $0.0044 | $0.0026 | $0.0066 | $0.0055 | $0.0001 | $0.0150 | $0.0224 | $0.0224 |
| 1979 | $1.18 | $2.07 | $10.35 | $18.14 | $0.0021 | $0.0031 | $0.0053 | $0.0052 | $0.0131 | $0.0070 | $0.0002 | $0.0179 | $0.0444 | $0.0444 |
| 1980 | $1.59 | $2.72 | $16.83 | $28.84 | $0.0027 | $0.0049 | $0.0060 | $0.0083 | $0.0208 | $0.0092 | $0.0004 | $0.0203 | $0.0706 | $0.0706 |
| 1981 | $1.98 | $3.32 | $33.66 | $56.40 | $0.0033 | $0.0096 | $0.0067 | $0.0162 | $0.0407 | $0.0113 | $0.0008 | $0.0226 | $0.1381 | $0.1381 |
| 1982 | $2.46 | $4.03 | $31.62 | $51.80 | $0.0040 | $0.0088 | $0.0074 | $0.0148 | $0.0374 | $0.0137 | $0.0007 | $0.0253 | $0.1269 | $0.1269 |
| 1983 | $2.59 | $4.15 | $28.72 | $46.01 | $0.0041 | $0.0078 | $0.0076 | $0.0132 | $0.0332 | $0.0141 | $0.0006 | $0.0259 | $0.1127 | $0.1127 |
| 1984 | $2.66 | $4.17 | $28.56 | $44.74 | $0.0042 | $0.0076 | $0.0077 | $0.0128 | $0.0323 | $0.0141 | $0.0006 | $0.0263 | $0.1096 | $0.1096 |
| 1985 | $2.51 | $3.84 | $28.72 | $43.99 | $0.0038 | $0.0075 | $0.0075 | $0.0126 | $0.0317 | $0.0130 | $0.0006 | $0.0254 | $0.1078 | $0.1078 |
| 1986 | $1.94 | $2.91 | $13.89 | $20.80 | $0.0029 | $0.0035 | $0.0066 | $0.0060 | $0.0150 | $0.0099 | $0.0003 | $0.0225 | $0.0509 | $0.0509 |
| 1987 | $1.67 | $2.45 | $17.31 | $25.35 | $0.0024 | $0.0043 | $0.0063 | $0.0073 | $0.0183 | $0.0083 | $0.0003 | $0.0213 | $0.0621 | $0.0621 |
| 1988 | $1.69 | $2.42 | $13.52 | $19.35 | $0.0024 | $0.0033 | $0.0063 | $0.0055 | $0.0140 | $0.0082 | $0.0003 | $0.0215 | $0.0474 | $0.0474 |
| 1989 | $1.69 | $2.37 | $17.14 | $23.99 | $0.0024 | $0.0041 | $0.0064 | $0.0069 | $0.0173 | $0.0080 | $0.0003 | $0.0216 | $0.0588 | $0.0588 |
| 1990 | $1.71 | $2.34 | $21.47 | $29.39 | $0.0023 | $0.0050 | $0.0064 | $0.0084 | $0.0212 | $0.0079 | $0.0004 | $0.0218 | $0.0720 | $0.0720 |
| 1991 | $1.64 | $2.20 | $17.21 | $23.04 | $0.0022 | $0.0039 | $0.0064 | $0.0066 | $0.0166 | $0.0075 | $0.0003 | $0.0216 | $0.0564 | $0.0564 |
| 1992 | $1.74 | $2.28 | $17.44 | $22.82 | $0.0023 | $0.0039 | $0.0066 | $0.0065 | $0.0165 | $0.0077 | $0.0003 | $0.0222 | $0.0559 | $0.0559 |
| 1993 | $2.04 | $2.61 | $15.45 | $19.78 | $0.0026 | $0.0034 | $0.0070 | $0.0057 | $0.0143 | $0.0089 | $0.0003 | $0.0237 | $0.0484 | $0.0484 |
| 1994 | $1.85 | $2.32 | $15.20 | $19.03 | $0.0023 | $0.0032 | $0.0068 | $0.0055 | $0.0137 | $0.0079 | $0.0003 | $0.0230 | $0.0466 | $0.0466 |
| 1995 | $1.55 | $1.90 | $16.93 | $20.72 | $0.0019 | $0.0035 | $0.0065 | $0.0059 | $0.0150 | $0.0064 | $0.0003 | $0.0220 | $0.0508 | $0.0508 |
| 1996 | $2.17 | $2.60 | $20.44 | $24.45 | $0.0026 | $0.0041 | $0.0073 | $0.0070 | $0.0176 | $0.0088 | $0.0003 | $0.0247 | $0.0599 | $0.0599 |
| 1997 | $2.32 | $2.71 | $18.98 | $22.21 | $0.0027 | $0.0038 | $0.0075 | $0.0064 | $0.0160 | $0.0092 | $0.0003 | $0.0254 | $0.0544 | $0.0544 |
| 1998 | $1.96 | $2.24 | $12.55 | $14.35 | $0.0022 | $0.0024 | $0.0071 | $0.0041 | $0.0104 | $0.0076 | $0.0002 | $0.0242 | $0.0352 | $0.0352 |
| 1999 | $2.19 | $2.45 | $17.73 | $19.83 | $0.0025 | $0.0034 | $0.0075 | $0.0075 | $0.0188 | $0.0083 | $0.0003 | $0.0253 | $0.0637 | $0.0637 |
| 2000 | $3.69 | $4.04 | $28.28 | $30.93 | $0.0040 | $0.0052 | $0.0091 | $0.0088 | $0.0222 | $0.0137 | $0.0004 | $0.0311 | $0.0755 | $0.0755 |
| 2001 | $4.12 | $4.41 | $23.21 | $24.82 | $0.0044 | $0.0042 | $0.0096 | $0.0079 | $0.0199 | $0.0150 | $0.0003 | $0.0327 | $0.0677 | $0.0677 |
| 2002 | $4.60 | $4.81 | $24.72 | $25.85 | $0.0048 | $0.0044 | $0.0102 | $0.0074 | $0.0185 | $0.0163 | $0.0004 | $0.0345 | $0.0629 | $0.0629 |
| 2003 | $5.50 | $5.62 | $29.64 | $30.31 | $0.0056 | $0.0051 | $0.0111 | $0.0078 | $0.0196 | $0.0191 | $0.0004 | $0.0377 | $0.0667 | $0.0667 |
| 2004 | $6.30 | $6.30 | $38.73 | $38.73 | $0.0063 | $0.0066 | $0.0119 | $0.0111 | $0.0279 | $0.0214 | $0.0005 | $0.0404 | $0.0949 | $0.0949 |

| | | | |
|---|---|---|---|
| 1 barrel of #2 diesel = | 42 gal. | | |
| 1 gallon of #2 diesel = | 135 MBTU | 15.8 KWh | |
| 1 cubic foot of natural gas = | 1 MBTU | 0.29463 KWh | |
| 1 barrel of ANS Crude = | 5900 MBTU | 1738.317 KWh | |

| | Cost of Norton Energy | | | | | |
|---|---|---|---|---|---|---|
| | No. 2 Diesel ($nominal/gal) | No. 2 Diesel w/ dock fee ($nominal/gal) | (2004$/gal) | No. 2 Diesel ($/bbl) | No. 2 Diesel (2004$/MBTU) | No. 2 Diesel (2004$/KWh) |
| 1999 | $0.87 | $0.90 | $1.01 | $42.29 | $0.0075 | $0.0637 |
| 2000 | $1.06 | $1.09 | $1.19 | $50.08 | $0.0088 | $0.0755 |
| 2001 | $0.97 | $1.00 | $1.07 | $44.92 | $0.0079 | $0.0677 |
| 2002 | $0.92 | $0.95 | $0.99 | $41.73 | $0.0074 | $0.0629 |
| 2003 | $1.00 | $1.03 | $1.05 | $44.24 | $0.0078 | $0.0667 |
| 2004 | $1.00 | $1.03 | $1.03 | $43.26 | $0.0076 | $0.0652 |
| **Average** | **$0.97** | **$1.00** | **$1.06** | **$44.42** | **$0.0078** | **$0.0669** |

**Energy Information Agency Projection**

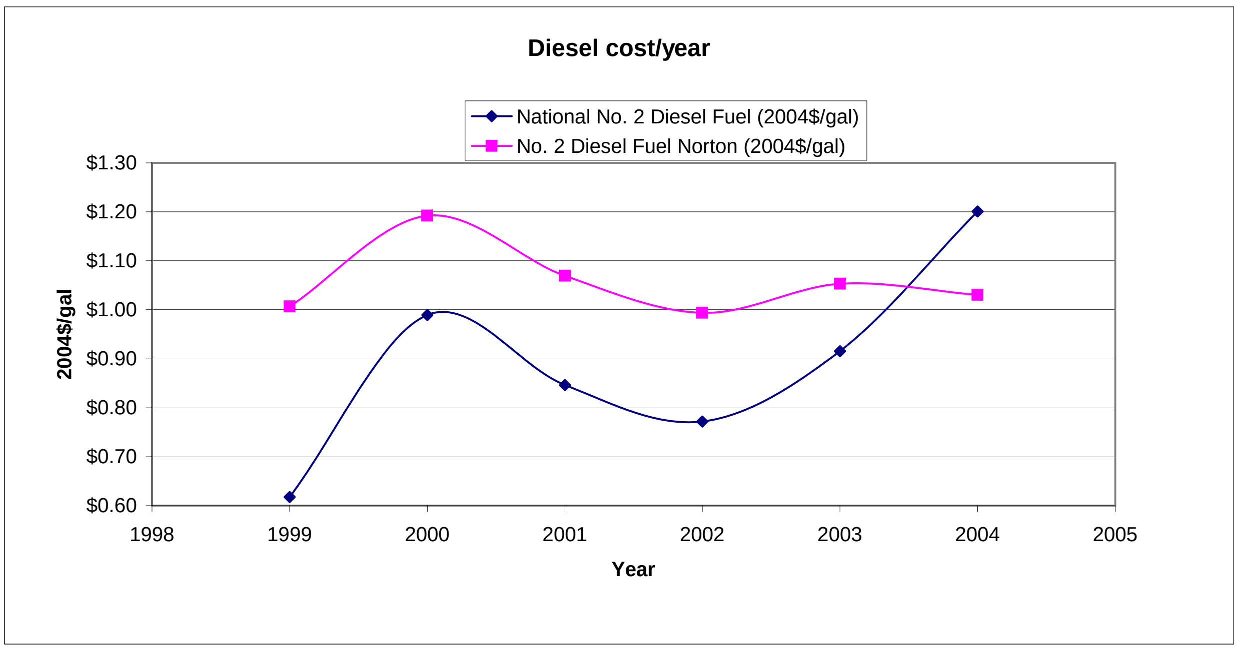
| Market Prices | Real Gas ($/Mcf) | Real ANS Oil ($/bbl) | Lower 48 Market Real Gas ($/MBTU) | Real ANS Oil @ W. Coast ($/MBTU) | W. Coast Gas Imported into Norton (2004$/MBTU) | No. 2 Diesel Fuel in Norton (2004$/MBTU) | Norton Natural Gas (2004$/MBTU) | Lower 48 Market Real Gas ($/KWh) | Real ANS Oil @ W. Coast ($/KWh) | W. Coast Gas Imported into Norton (2004$/KWh) | No. 2 Diesel Fuel in Norton (2004$/KWh) | Norton Natural Gas (2004$/KWh) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | $3.10 | $28.19 | $0.00310 | $0.0048 | $0.0090 | $0.0081 | $0.0203 | $0.01052 | $0.0004 | $0.0304 | $0.0690 | $0.0690 |
| 2006 | $3.17 | $28.83 | $0.00317 | $0.0049 | $0.0092 | $0.0083 | $0.0208 | $0.01076 | $0.0004 | $0.0311 | $0.0706 | $0.0706 |
| 2007 | $3.24 | $29.49 | $0.00324 | $0.0050 | $0.0094 | $0.0085 | $0.0213 | $0.01101 | $0.0004 | $0.0318 | $0.0722 | $0.0722 |
| 2008 | $3.32 | $30.15 | $0.00332 | $0.0051 | $0.0096 | $0.0086 | $0.0218 | $0.01126 | $0.0004 | $0.0325 | $0.0739 | $0.0739 |
| 2009 | $3.39 | $30.84 | $0.00339 | $0.0052 | $0.0098 | $0.0088 | $0.0223 | $0.01151 | $0.0004 | $0.0332 | $0.0755 | $0.0755 |
| 2010 | $3.47 | $31.54 | $0.00347 | $0.0053 | $0.0100 | $0.0090 | $0.0228 | $0.01177 | $0.0004 | $0.0340 | $0.0772 | $0.0772 |
| 2011 | $3.55 | $32.25 | $0.00355 | $0.0055 | $0.0102 | $0.0092 | $0.0233 | $0.01204 | $0.0004 | $0.0348 | $0.0790 | $0.0790 |
| 2012 | $3.63 | $32.99 | $0.00363 | $0.0056 | $0.0105 | $0.0095 | $0.0238 | $0.01231 | $0.0005 | $0.0355 | $0.0808 | $0.0808 |
| 2013 | $3.71 | $33.73 | $0.00371 | $0.0057 | $0.0107 | $0.0097 | $0.0243 | $0.01259 | $0.0005 | $0.0364 | $0.0826 | $0.0826 |
| 2014 | $3.79 | $34.50 | $0.00379 | $0.0058 | $0.0110 | $0.0099 | $0.0249 | $0.01288 | $0.0005 | $0.0372 | $0.0845 | $0.0845 |
| 2015 | $3.88 | $35.28 | $0.00388 | $0.0060 | $0.0112 | $0.0101 | $0.0255 | $0.01317 | $0.0005 | $0.0380 | $0.0864 | $0.0864 |
| 2016 | $3.97 | $36.08 | $0.00397 | $0.0061 | $0.0115 | $0.0103 | $0.0260 | $0.01347 | $0.0005 | $0.0389 | $0.0884 | $0.0884 |
| 2017 | $4.06 | $36.90 | $0.00406 | $0.0063 | $0.0117 | $0.0106 | $0.0266 | $0.01377 | $0.0005 | $0.0398 | $0.0904 | $0.0904 |
| 2018 | $4.15 | $37.74 | $0.00415 | $0.0064 | $0.0120 | $0.0108 | $0.0272 | $0.01409 | $0.0005 | $0.0407 | $0.0924 | $0.0924 |
| 2019 | $4.24 | $38.60 | $0.00424 | $0.0065 | $0.0123 | $0.0111 | $0.0279 | $0.01441 | $0.0005 | $0.0416 | $0.0945 | $0.0945 |
| 2020 | $4.34 | $39.47 | $0.00434 | $0.0067 | $0.0125 | $0.0113 | $0.0285 | $0.01473 | $0.0005 | $0.0425 | $0.0967 | $0.0967 |
| 2021 | $4.44 | $40.37 | $0.00444 | $0.0068 | $0.0128 | $0.0116 | $0.0291 | $0.01507 | $0.0006 | $0.0435 | $0.0989 | $0.0989 |
| 2022 | $4.54 | $41.28 | $0.00454 | $0.0070 | $0.0131 | $0.0118 | $0.0298 | $0.01541 | $0.0006 | $0.0445 | $0.1011 | $0.1011 |
| 2023 | $4.64 | $42.22 | $0.00464 | $0.0072 | $0.0134 | $0.0121 | $0.0305 | $0.01576 | $0.0006 | $0.0455 | $0.1034 | $0.1034 |
| 2024 | $4.75 | $43.18 | $0.00475 | $0.0073 | $0.0137 | $0.0124 | $0.0312 | $0.01612 | $0.0006 | $0.0465 | $0.1058 | $0.1058 |
| 2025 | $4.86 | $44.16 | $0.00486 | $0.0075 | $0.0140 | $0.0127 | $0.0319 | $0.01648 | $0.0006 | $0.0476 | $0.1082 | $0.1082 |
| 2026 | $4.97 | $45.16 | $0.00497 | $0.0077 | $0.0143 | $0.0129 | $0.0326 | $0.01686 | $0.0006 | $0.0487 | $0.1106 | $0.1106 |
| 2027 | $5.08 | $46.18 | $0.00508 | $0.0078 | $0.0147 | $0.0132 | $0.0333 | $0.01724 | $0.0006 | $0.0498 | $0.1131 | $0.1131 |
| 2028 | $5.19 | $47.23 | $0.00519 | $0.0080 | $0.0150 | $0.0135 | $0.0341 | $0.01763 | $0.0006 | $0.0509 | $0.1157 | $0.1157 |
| 2029 | $5.31 | $48.30 | $0.00531 | $0.0082 | $0.0153 | $0.0138 | $0.0349 | $0.01803 | $0.0007 | $0.0521 | $0.1183 | $0.1183 |
| 2030 | $5.43 | $49.40 | $0.00543 | $0.0084 | $0.0157 | $0.0142 | $0.0356 | $0.01844 | $0.0007 | $0.0532 | $0.1210 | $0.1210 |
| 2031 | $5.56 | $50.52 | $0.00556 | $0.0086 | $0.0160 | $0.0145 | $0.0365 | $0.01886 | $0.0007 | $0.0544 | $0.1237 | $0.1237 |
| 2032 | $5.68 | $51.67 | $0.0057 | $0.0088 | $0.0164 | $0.0148 | $0.0373 | $0.0193 | $0.0007 | $0.0557 | $0.1265 | $0.1265 |
| 2033 | $5.81 | $52.84 | $0.0058 | $0.0090 | $0.0168 | $0.0151 | $0.0381 | $0.0197 | $0.0007 | $0.0569 | $0.1294 | $0.1294 |
| 2034 | $5.94 | $54.04 | $0.0059 | $0.0092 | $0.0172 | $0.0155 | $0.0390 | $0.0202 | $0.0007 | $0.0582 | $0.1324 | $0.1324 |
| 2035 | $6.08 | $55.27 | $0.0061 | $0.0094 | $0.0175 | $0.0158 | $0.0399 | $0.0206 | $0.0008 | $0.0596 | $0.1354 | $0.1354 |
| 2036 | $6.22 | $56.52 | $0.0062 | $0.0096 | $0.0179 | $0.0162 | $0.0408 | $0.0211 | $0.0008 | $0.0609 | $0.1384 | $0.1384 |
| 2037 | $6.36 | $57.80 | $0.0064 | $0.0098 | $0.0184 | $0.0166 | $0.0417 | $0.0216 | $0.0008 | $0.0623 | $0.1416 | $0.1416 |
| 2038 | $6.50 | $59.11 | $0.0065 | $0.0100 | $0.0188 | $0.0169 | $0.0427 | $0.0221 | $0.0008 | $0.0637 | $0.1448 | $0.1448 |
| 2039 | $6.65 | $60.45 | $0.0066 | $0.0102 | $0.0192 | $0.0173 | $0.0436 | $0.0226 | $0.0008 | $0.0651 | $0.1481 | $0.1481 |
| 2040 | $6.80 | $61.83 | $0.0068 | $0.0105 | $0.0196 | $0.0177 | $0.0446 | $0.0231 | $0.0008 | $0.0666 | $0.1514 | $0.1514 |
| 2041 | $6.95 | $63.23 | $0.0070 | $0.0107 | $0.0201 | $0.0181 | $0.0456 | $0.0236 | $0.0009 | $0.0681 | $0.1549 | $0.1549 |
| 2042 | $7.11 | $64.66 | $0.0071 | $0.0110 | $0.0205 | $0.0185 | $0.0467 | $0.0241 | $0.0009 | $0.0697 | $0.1584 | $0.1584 |
| 2043 | $7.27 | $66.13 | $0.0073 | $0.0112 | $0.0210 | $0.0190 | $0.0477 | $0.0247 | $0.0009 | $0.0713 | $0.1620 | $0.1620 |
| 2044 | $7.44 | $67.63 | $0.0074 | $0.0115 | $0.0215 | $0.0194 | $0.0488 | $0.0252 | $0.0009 | $0.0729 | $0.1656 | $0.1656 |
| 2045 | $7.61 | $69.17 | $0.0076 | $0.0117 | $0.0220 | $0.0198 | $0.0499 | $0.0258 | $0.0009 | $0.0745 | $0.1694 | $0.1694 |
| 2046 | $7.78 | $70.74 | $0.0078 | $0.0120 | $0.0225 | $0.0203 | $0.0510 | $0.0264 | $0.0010 | $0.0762 | $0.1732 | $0.1732 |
| 2047 | $7.96 | $72.34 | $0.0080 | $0.0123 | $0.0230 | $0.0207 | $0.0522 | $0.0270 | $0.0010 | $0.0780 | $0.1772 | $0.1772 |
| 2048 | $8.14 | $73.98 | $0.0081 | $0.0125 | $0.0235 | $0.0212 | $0.0534 | $0.0276 | $0.0010 | $0.0797 | $0.1812 | $0.1812 |
| 2049 | $8.32 | $75.66 | $0.0083 | $0.0128 | $0.0240 | $0.0217 | $0.0546 | $0.0282 | $0.0010 | $0.0815 | $0.1853 | $0.1853 |
| 2050 | $8.51 | $77.38 | $0.0085 | $0.0131 | $0.0246 | $0.0222 | $0.0558 | $0.0289 | $0.0011 | $0.0834 | $0.1895 | $0.1895 |
| 2051 | $8.70 | $79.13 | $0.0087 | $0.0134 | $0.0251 | $0.0227 | $0.0571 | $0.0295 | $0.0011 | $0.0853 | $0.1938 | $0.1938 |
| 2052 | $8.90 | $80.93 | $0.0089 | $0.0137 | $0.0257 | $0.0232 | $0.0584 | $0.0302 | $0.0011 | $0.0872 | $0.1982 | $0.1982 |
| 2053 | $9.10 | $82.77 | $0.0091 | $0.0140 | $0.0263 | $0.0237 | $0.0597 | $0.0309 | $0.0011 | $0.0892 | $0.2027 | $0.2027 |
| 2054 | $9.31 | $84.64 | $0.0093 | $0.0143 | $0.0269 | $0.0243 | $0.0611 | $0.0316 | $0.0012 | $0.0912 | $0.2073 | $0.2073 |
| 2055 | $9.52 | $86.56 | $0.0095 | $0.0147 | $0.0275 | $0.0248 | $0.0625 | $0.0323 | $0.0012 | $0.0933 | $0.2120 | $0.2120 |
| 2056 | $9.74 | $88.53 | $0.0097 | $0.0150 | $0.0281 | $0.0254 | $0.0639 | $0.0330 | $0.0012 | $0.0954 | $0.2168 | $0.2168 |
| 2057 | $9.96 | $90.54 | $0.0100 | $0.0153 | $0.0287 | $0.0260 | $0.0653 | $0.0338 | $0.0012 | $0.0976 | $0.2217 | $0.2217 |
| 2058 | $10.18 | $92.59 | $0.0102 | $0.0157 | $0.0294 | $0.0265 | $0.0668 | $0.0346 | $0.0013 | $0.0998 | $0.2268 | $0.2268 |

**Regression Projection**

| Market Prices | Real Gas ($/Mcf) | Real ANS Oil ($/bbl) | Lower 48 Market Real Gas ($/MBTU) | Real ANS Oil @ W. Coast ($/MBTU) | W. Coast Gas Imported into Norton (2004$/MBTU) | No. 2 Diesel Fuel in Norton (2004$/MBTU) | Norton Natural Gas (2004$/MBTU) | Lower 48 Market Real Gas ($/KWh) | Real ANS Oil @ W. Coast ($/KWh) | W. Coast Gas Imported into Norton (2004$/KWh) | No. 2 Diesel Fuel in Norton (2004$/KWh) | Norton Natural Gas (2004$/KWh) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | $4.17 | $29.28 | $0.00417 | $0.0050 | $0.0092 | $0.0086 | $0.0076 | $0.01415 | $0.0004 | $0.0311 | $0.0731 | $0.0257 |
| 2006 | $4.25 | $29.80 | $0.00425 | $0.0051 | $0.0093 | $0.0087 | $0.0077 | $0.01443 | $0.0004 | $0.0314 | $0.0744 | $0.0262 |
| 2007 | $4.33 | $30.32 | $0.00433 | $0.0051 | $0.0093 | $0.0089 | $0.0079 | $0.01471 | $0.0004 | $0.0317 | $0.0758 | $0.0267 |
| 2008 | $4.42 | $30.84 | $0.00442 | $0.0052 | $0.0094 | $0.0090 | $0.0080 | $0.01499 | $0.0004 | $0.0320 | $0.0771 | $0.0273 |
| 2009 | $4.50 | $31.36 | $0.00450 | $0.0053 | $0.0095 | $0.0092 | $0.0082 | $0.01527 | $0.0004 | $0.0322 | $0.0784 | $0.0278 |
| 2010 | $4.58 | $31.88 | $0.00458 | $0.0054 | $0.0096 | $0.0093 | $0.0083 | $0.01555 | $0.0004 | $0.0325 | $0.0797 | $0.0283 |
| 2011 | $4.66 | $32.40 | $0.00466 | $0.0055 | $0.0097 | $0.0095 | $0.0085 | $0.01583 | $0.0004 | $0.0328 | $0.0811 | $0.0288 |
| 2012 | $4.75 | $32.92 | $0.00475 | $0.0056 | $0.0097 | $0.0096 | $0.0087 | $0.01611 | $0.0005 | $0.0331 | $0.0824 | $0.0294 |
| 2013 | $4.83 | $33.43 | $0.00483 | $0.0057 | $0.0098 | $0.0098 | $0.0088 | $0.01639 | $0.0005 | $0.0334 | $0.0837 | $0.0299 |
| 2014 | $4.91 | $33.95 | $0.00491 | $0.0058 | $0.0099 | $0.0100 | $0.0090 | $0.01667 | $0.0005 | $0.0336 | $0.0850 | $0.0304 |
| 2015 | $4.99 | $34.47 | $0.00499 | $0.0058 | $0.0100 | $0.0101 | $0.0091 | $0.01695 | $0.0005 | $0.0339 | $0.0864 | $0.0309 |
| 2016 | $5.08 | $34.99 | $0.00508 | $0.0059 | $0.0101 | $0.0103 | $0.0093 | $0.01723 | $0.0005 | $0.0342 | $0.0877 | $0.0315 |
| 2017 | $5.16 | $35.51 | $0.00516 | $0.0060 | $0.0102 | $0.0104 | $0.0094 | $0.01750 | $0.0005 | $0.0345 | $0.0890 | $0.0320 |
| 2018 | $5.24 | $36.03 | $0.00524 | $0.0061 | $0.0102 | $0.0106 | $0.0096 | $0.01778 | $0.0005 | $0.0348 | $0.0904 | $0.0325 |
| 2019 | $5.32 | $36.55 | $0.00532 | $0.0062 | $0.0103 | $0.0107 | $0.0097 | $0.01806 | $0.0005 | $0.0350 | $0.0917 | $0.0331 |
| 2020 | $5.40 | $37.07 | $0.00540 | $0.0063 | $0.0104 | $0.0109 | $0.0099 | $0.01834 | $0.0005 | $0.0353 | $0.0930 | $0.0336 |
| 2021 | $5.49 | $37.59 | $0.00549 | $0.0064 | $0.0105 | $0.0110 | $0.0100 | $0.01862 | $0.0005 | $0.0356 | $0.0943 | $0.0341 |
| 2022 | $5.57 | $38.10 | $0.00557 | $0.0065 | $0.0106 | $0.0112 | $0.0102 | $0.01890 | $0.0005 | $0.0359 | $0.0957 | $0.0346 |
| 2023 | $5.65 | $38.62 | $0.00565 | $0.0065 | $0.0107 | $0.0114 | $0.0104 | $0.01918 | $0.0005 | $0.0362 | $0.0970 | $0.0352 |
| 2024 | $5.73 | $39.14 | $0.00573 | $0.0066 | $0.0107 | $0.0115 | $0.0105 | $0.01946 | $0.0005 | $0.0364 | $0.0983 | $0.0357 |
| 2025 | $5.82 | $39.66 | $0.00582 | $0.0067 | $0.0108 | $0.0117 | $0.0107 | $0.01974 | $0.0005 | $0.0367 | $0.0997 | $0.0362 |
| 2026 | $5.90 | $40.18 | $0.00590 | $0.0068 | $0.0109 | $0.0118 | $0.0108 | $0.02002 | $0.0006 | $0.0370 | $0.1010 | $0.0367 |
| 2027 | $5.98 | $40.70 | $0.00598 | $0.0069 | $0.0110 | $0.0120 | $0.0110 | $0.02030 | $0.0006 | $0.0373 | $0.1023 | $0.0373 |
| 2028 | $6.06 | $41.22 | $0.00606 | $0.0070 | $0.0111 | $0.0121 | $0.0111 | $0.02058 | $0.0006 | $0.0376 | $0.1036 | $0.0378 |
| 2029 | $6.15 | $41.74 | $0.00615 | $0.0071 | $0.0111 | $0.0123 | $0.0113 | $0.02086 | $0.0006 | $0.0378 | $0.1050 | $0.0383 |
| 2030 | $6.23 | $42.25 | $0.00623 | $0.0072 | $0.0112 | $0.0124 | $0.0114 | $0.02114 | $0.0006 | $0.0381 | $0.1063 | $0.0389 |
| 2031 | $6.31 | $42.77 | $0.00631 | $0.0072 | $0.0113 | $0.0126 | $0.0116 | $0.02142 | $0.0006 | $0.0384 | $0.1076 | $0.0394 |
| 2032 | $6.39 | $43.29 | $0.0064 | $0.0073 | $0.0114 | $0.0128 | $0.0118 | $0.02170 | $0.0006 | $0.0387 | $0.1089 | $0.0399 |
| 2033 | $6.48 | $43.81 | $0.0065 | $0.0074 | $0.0115 | $0.0129 | $0.0119 | $0.02198 | $0.0006 | $0.0389 | $0.1103 | $0.0404 |
| 2034 | $6.56 | $44.33 | $0.0066 | $0.0075 | $0.0116 | $0.0131 | $0.0121 | $0.02226 | $0.0006 | $0.0392 | $0.1116 | $0.0410 |
| 2035 | $6.64 | $44.85 | $0.0066 | $0.0076 | $0.0116 | $0.0132 | $0.0122 | $0.02254 | $0.0006 | $0.0395 | $0.1129 | $0.0415 |
| 2036 | $6.72 | $45.37 | $0.0067 | $0.0077 | $0.0117 | $0.0134 | $0.0124 | $0.02282 | $0.0006 | $0.0398 | $0.1143 | $0.0420 |
| 2037 | $6.80 | $45.89 | $0.0068 | $0.0078 | $0.0118 | $0.0135 | $0.0125 | $0.02310 | $0.0006 | $0.0401 | $0.1156 | $0.0425 |
| 2038 | $6.89 | $46.41 | $0.0069 | $0.0079 | $0.0119 | $0.0137 | $0.0127 | $0.02338 | $0.0006 | $0.0403 | $0.1169 | $0.0431 |
| 2039 | $6.97 | $46.92 | $0.0070 | $0.0080 | $0.0120 | $0.0138 | $0.0128 | $0.02366 | $0.0006 | $0.0406 | $0.1182 | $0.0436 |
| 2040 | $7.05 | $47.44 | $0.0071 | $0.0080 | $0.0121 | $0.0140 | $0.0130 | $0.02394 | $0.0006 | $0.0409 | $0.1196 | $0.0441 |
| 2041 | $7.13 | $47.96 | $0.0071 | $0.0081 | $0.0121 | $0.0141 | $0.0132 | $0.02421 | $0.0007 | $0.0412 | $0.1209 | $0.0447 |
| 2042 | $7.22 | $48.48 | $0.0072 | $0.0082 | $0.0122 | $0.0143 | $0.0133 | $0.02449 | $0.0007 | $0.0415 | $0.1222 | $0.0452 |
| 2043 | $7.30 | $49.00 | $0.0073 | $0.0083 | $0.0123 | $0.0145 | $0.0135 | $0.02477 | $0.0007 | $0.0417 | $0.1235 | $0.0457 |
| 2044 | $7.38 | $49.52 | $0.0074 | $0.0084 | $0.0124 | $0.0146 | $0.0136 | $0.02505 | $0.0007 | $0.0420 | $0.1249 | $0.0462 |
| 2045 | $7.46 | $50.04 | $0.0075 | $0.0085 | $0.0125 | $0.0148 | $0.0138 | $0.02533 | $0.0007 | $0.0423 | $0.1262 | $0.0468 |
| 2046 | $7.55 | $50.56 | $0.0075 | $0.0086 | $0.0125 | $0.0149 | $0.0139 | $0.02561 | $0.0007 | $0.0426 | $0.1275 | $0.0473 |
| 2047 | $7.63 | $51.07 | $0.0076 | $0.0087 | $0.0126 | $0.0151 | $0.0141 | $0.02589 | $0.0007 | $0.0429 | $0.1289 | $0.0478 |
| 2048 | $7.71 | $51.59 | $0.0077 | $0.0087 | $0.0127 | $0.0152 | $0.0142 | $0.02617 | $0.0007 | $0.0431 | $0.1302 | $0.0483 |
| 2049 | $7.79 | $52.11 | $0.0078 | $0.0088 | $0.0128 | $0.0154 | $0.0144 | $0.02645 | $0.0007 | $0.0434 | $0.1315 | $0.0489 |
| 2050 | $7.88 | $52.63 | $0.0079 | $0.0089 | $0.0129 | $0.0155 | $0.0146 | $0.02673 | $0.0007 | $0.0437 | $0.1328 | $0.0494 |
| 2051 | $7.96 | $53.15 | $0.0080 | $0.0090 | $0.0130 | $0.0157 | $0.0147 | $0.02701 | $0.0007 | $0.0440 | $0.1342 | $0.0499 |
| 2052 | $8.04 | $53.67 | $0.0080 | $0.0091 | $0.0130 | $0.0159 | $0.0149 | $0.02729 | $0.0007 | $0.0443 | $0.1355 | $0.0505 |
| 2053 | $8.12 | $54.19 | $0.0081 | $0.0092 | $0.0131 | $0.0160 | $0.0150 | $0.02757 | $0.0007 | $0.0445 | $0.1368 | $0.0510 |
| 2054 | $8.21 | $54.71 | $0.0082 | $0.0093 | $0.0132 | $0.0162 | $0.0152 | $0.02785 | $0.0007 | $0.0448 | $0.1382 | $0.0515 |
| 2055 | $8.29 | $55.23 | $0.0083 | $0.0094 | $0.0133 | $0.0163 | $0.0153 | $0.02813 | $0.0008 | $0.0451 | $0.1395 | $0.0520 |
| 2056 | $8.37 | $55.74 | $0.0084 | $0.0094 | $0.0134 | $0.0165 | $0.0155 | $0.02841 | $0.0008 | $0.0454 | $0.1408 | $0.0526 |
| 2057 | $8.45 | $56.26 | $0.0085 | $0.0095 | $0.0135 | $0.0166 | $0.0156 | $0.02869 | $0.0008 | $0.0457 | $0.1421 | $0.0531 |
| 2058 | $8.53 | $56.78 | $0.0085 | $0.0096 | $0.0135 | $0.0168 | $0.0158 | $0.02897 | $0.0008 | $0.0459 | $0.1435 | $0.0536 |

## Appendix 9: Norton Factors
## Represents energy ratios for the Norton Sound area.

| | A | B | C | D | E | G | H | I | J | K | H | I |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | National No. 2 Diesel Fuel ($/gal) | National No. 2 Diesel Fuel (2004$/gal) | No. 2 Diesel Fuel Norton (2004$/gal) | No. 2 Diesel Fuel Norton (2004$/KWH) | No. 2 Diesel Fuel Norton (2004$/BTU) | W. Coast Market Real Gas ($/MBTU) | Real ANS Oil ($/bbl) | Real ANS Oil ($/gal) | No. 2 Diesel/Oil Ratio | Norton No. 2 Diesel/Oil Ratio | Real Gas/Norton No. 2 Diesel Ratio |
| 2 | **1994** | $0.54 | $0.67 | n/a | n/a | n/a | $0.00 | $19.03 | $0.45 | $1.49 | n/a | n/a |
| 3 | **1995** | $0.55 | $0.67 | n/a | n/a | n/a | $0.00 | $20.72 | $0.49 | $1.35 | n/a | n/a |
| 4 | **1996** | $0.67 | $0.80 | n/a | n/a | n/a | $0.00 | $24.45 | $0.58 | $1.37 | n/a | n/a |
| 5 | **1997** | $0.62 | $0.72 | n/a | n/a | n/a | $0.00 | $22.21 | $0.53 | $1.36 | n/a | n/a |
| 6 | **1998** | $0.45 | $0.52 | n/a | n/a | n/a | $0.00 | $14.35 | $0.34 | $1.52 | n/a | n/a |
| 7 | **1999** | $0.55 | $0.62 | $1.01 | $0.06 | $0.01 | $0.00 | $19.83 | $0.47 | $1.31 | $2.13 | $3.04 |
| 8 | **2000** | $0.90 | $0.99 | $1.19 | $0.08 | $0.01 | $0.00 | $30.93 | $0.74 | $1.34 | $1.62 | $2.19 |
| 9 | **2001** | $0.79 | $0.85 | $1.07 | $0.07 | $0.01 | $0.00 | $24.82 | $0.59 | $1.43 | $1.81 | $1.80 |
| 10 | **2002** | $0.74 | $0.77 | $0.99 | $0.06 | $0.01 | $0.00 | $25.85 | $0.62 | n/a | $1.61 | $1.53 |
| 11 | **2003** | $0.90 | $0.92 | $1.05 | $0.07 | $0.01 | $0.01 | $30.31 | $0.72 | n/a | $1.46 | $1.39 |
| 12 | **2004** | $1.20 | $1.20 | $1.03 | $0.07 | $0.01 | $0.01 | $38.73 | $0.92 | n/a | $1.12 | $1.21 |
| 12 | **Average** | **$0.72** | **$0.79** | **$1.06** | **$0.07** | **$0.01** | **$0.00** | **$24.66** | **$0.59** | **$1.40** | **$1.63** | **$1.86** |



# Appendix 10: Volumetric Prospect Assessment
# Basin Name: Mid-Tertiary West Sub-basin Fill

This spreadsheet represents the geological attributes of the specified basin and briefly summarizes a few formation characteristics.

| | |
|---|---|
| **Gas gravity =** | 0.66 |
| **Gas molar weight =** | 16 |
| **$CO_2$ =** | 10% |
| **$N_2$ =** | 0% |
| **$H_2S$ =** | 0% |
| **Average Depth (ft) =** | 5500 |
| **Well Type** | Dry |

| | |
|---|---|
| **$P_{sc}$ (psi) =** | 14.7 |
| **$T_{sc}$ (F) =** | 32 |
| **$r_w$ (ft) =** | 0.3 |
| **$P_a$ (abandonment** | 300 |
| **$T_a$ (abandonment** | 612.270 |
| **Well Spacing (acres)** | 480 |
| **Pressure gradient (psi/ft)** | 0.45 |
| **Temperature gradient (F/100ft)** | 2.68 |

**Select Tubing sizes, d (in)**

(Used for Interpolation & Charts unless specified)

| | |
|---|---|
| **1** | 1 |
| **2** | 2 |
| **3** | 3 |
| **4** | 4 |

Procedure = Take P2 and P50 to establish distribution. Use P5 and P95 for truncation and then take all subsequent P values, except ratios bounded by 0,1.

***Inputs***

| | Distribution Inputs 50% | 2% | Lower Truncation | Upper Truncation | Distribution | Justification |
|---|---|---|---|---|---|---|
| **Trap volume** | | | | | | |
| *Net volume (scf)* | | | | | | |
| *Prospect Closure Area (acres)* | | | | | | |
| *Closure Area ($ft^2$)* | | | | | | |
| *$R_e$ (ft), radius of external boundary* | | | | | | |
| *Net Reservoir Thickness (ft)* | 150 | 320 | 0 | 490 | lognormal | Definition |
| **Reservoir Properties** | | | | | | |
| *Average Net/Gross (ratio)* | 0.6 | 0.6824 | 0.444 | 0.656 | normal | Percentage |
| *Average Porosity (fraction)* | 15 | 0.2 | 0.0919 | 0.1881 | normal | Percentage |
| *Average HC Saturation* | 0.7 | 0.76 | 0.6159 | 0.7441 | normal | Percentage |
| *HC Fill* | 0.548 | 0.85 | 0.255 | 0.833 | normal | Percentage |
| *Reservoir Temp. R* | | | | | | |
| *Reservoir Press. (psi)* | | | | | | |
| *Pseudocritical Temperature R* | | | | | | |
| *Pseudocritical Pressure (psi)* | | | | | | |
| *Pseudoreduced Temperature R* | | | | | | |
| *Pseudoreduced Pressure (psi)* | | | | | | |
| *Z-factor* | | | | | | |
| *Free Gas Recovery (RF) (efficiency)* | | | | | | |
| *Oil Fraction of HC Volume* | | | | | | |
| *Free Gas Volume Factor (cu ft/scf) (Bg)* | | | | | | |
| *Free Gas Volume Factor (acre-ft/scf) (Bg)* | | | | | | |
| *Reciprocal Free Gas Volume Factor (scf/cu ft) (1/Bg)* | | | | | | |
| *Reciprocal Free Gas Volume Factor (scf/acre-ft) (1/Bg)* | | | | | | |
| *Free Gas Frac. of HC Volume (aka. Prop. Gas Bearing)* | | | | | | |
| *# of Prospects* | | | | | | |
| *Shrinkage Factor* | 0.9 | 0.98 | 0.8359 | 0.9641 | normal | Percentage |
| *Permeability* | | | | | | |

***Outputs***

| | Mean Value |
|---|---|
| **Trap volume** | |
| *Net volume (scf)* | 86,698,273,739.731 |
| *Prospect Closure Area (acres)* | 12,422.730 |
| *Closure Area ($ft^2$)* | 541,134,118.800 |
| *$R_e$ (ft), radius of external boundary* | 11,631.145 |
| *Net Reservoir Thickness (ft)* | 160.216 |
| **Reservoir Properties** | |
| *Average Net/Gross (ratio)* | 0.593 |
| *Average Porosity (fraction)* | 0.151 |
| *Average HC Saturation* | 0.696 |
| *HC Fill* | 0.546 |
| *Reservoir Temp. (R)* | 612.270 |
| *Reservoir Press. (psi)* | 2,489.700 |
| *Pseudocritical Temperature (R)* | 376.723 |
| *Pseudocritical Pressure (psi)* | 670.572 |
| *Pseudoreduced Temperature (R)* | 1.625 |
| *Pseudoreduced Pressure (psi)* | 3.713 |
| *Z-factor* | 1.015 |
| *Free Gas Recovery (RF) (efficiency)* | 0.820 |
| *Oil Fraction of HC Volume* | 0.000 |
| *Free Gas Volume Factor (cu ft/scf) (Bg)* | 0.00706 |
| *Free Gas Volume Factor (acre-ft/scf) (Bg)* | 0.0000002 |
| *Reciprocal Free Gas Volume Factor (scf/cu ft) (1/Bg)* | 141.583 |
| *Reciprocal Free Gas Volume Factor (scf/acre-ft) (1/Bg)* | 6167372.650 |
| *Free Gas Frac. of HC Volume (aka. Prop. Gas Bearing)* | 0.900 |
| *# of Prospects* | 1.000 |
| *Shrinkage Factor* | 0.900 |
| *Permeability (md)* | 90 |

## AOF

| | | |
|---|---|---|
| Formation Conditions | **Initial Unrisked In Place Pool Size (Bcf)** | 375.502 |
| | **Initial Unrisked Recoverable free gas (Bcf) G** | 307.911 |
| | **Formation Gas Recovery Factor (MMcf/acre-ft) Eg** | 0.477 |
| Surface Conditions | **Final Unrisked Recoverable free gas (Bscf) G** | 216.019 |
| | **Final Free Gas Recovery (RF) (efficiency)** | 0.386 |
| | **Formation Gas Recovery Factor (MMcf/acre-ft) Eg** | 0.225 |
| | **Average Flow Rate (MMscf/D)** | 55.348 |
| | **Production time to Abandonment (years)** | 33.495 |
| | **Peak Flow Rate (MMscf/D)** | 115.961 |
| | **# of Wells if fully developed** | 25.881 |

Inputs

Calculation non-outputs

Outputs

@Risk Dist. from data

Permanent

Inputs following @Risk Inputs

# Appendix 11:

**Absolute Open Flow**

**Calculated Unrestricted Flow Data** | **Interpolated data from calculated data.**

| *Time (years)* | *Cumulative $G_p$ (Bscf)* | *$q_g$ (MMscf/D)* | *$G_p$ (Bscf)* | *Time (years)* | *Cumulative $G_p$ (Bscf)* | *$q_g$ (MMscf/D)* | *$G_p$ (Bscf)* | % produced |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0% |
| 0.363264812 | 15.3755 | 115.9609665 | 15.37545664 | 1 | 35.93391473 | 99.86978116 | 16.307 | 17% |
| 0.833928639 | 31.3838 | 103.1060329 | 16.00836526 | 2 | 60.33303238 | 83.47995212 | 16.924 | 29% |
| 1.438995423 | 47.9617 | 91.31502678 | 16.57787364 | 3 | 78.93917846 | 72.60998045 | 17.337 | 38% |
| 2.212368766 | 65.0162 | 80.51397786 | 17.05451707 | 4 | 93.71722085 | 64.84018264 | 17.538 | 45% |
| 3.197143224 | 82.4241 | 70.63161866 | 17.40786877 | 5 | 106.1350751 | 58.75044965 | 17.623 | 51% |
| 4.449149636 | 100.0350 | 61.60022571 | 17.61096558 | 6 | 117.2089139 | 53.57703733 | 17.645 | 56% |
| 6.042615481 | 117.6808 | 53.35656988 | 17.64578388 | 7 | 125.9106492 | 49.82468472 | 17.581 | 60% |
| 8.079341508 | 135.1888 | 45.8428883 | 17.50799704 | 8 | 134.5067966 | 46.13558689 | 17.513 | 64% |
| 10.70372063 | 152.3977 | 39.00774547 | 17.20889569 | 9 | 141.2258809 | 43.44505171 | 17.403 | 67% |
| 14.12770098 | 169.1711 | 32.80663953 | 16.77335006 | 10 | 147.7832017 | 40.84057174 | 17.289 | 70% |
| 18.67348206 | 185.4057 | 27.20224776 | 16.2345766 | 11 | 153.8491331 | 38.47115951 | 17.171 | 73% |
| 24.84974316 | 201.0335 | 22.16428406 | 15.62786939 | 12 | 158.74792 | 36.66007846 | 17.044 | 76% |
| 33.4954951 | 216.0190 | 17.66902636 | 14.98544723 | 13 | 163.6467068 | 34.84899741 | 16.917 | 78% |
| 46.07050026 | 230.3525 | 13.69862753 | 14.33349066 | 14 | 168.5454937 | 33.03791636 | 16.790 | 80% |
| 65.2921005 | 244.0437 | 10.24033514 | 13.69128418 | 15 | 172.286359 | 31.73120159 | 16.670 | 82% |
| 96.6857981 | 257.1155 | 7.285724116 | 13.0717669 | 16 | 175.8577093 | 30.49832397 | 16.551 | 84% |
| 152.9241516 | 269.5982 | 4.830011016 | 12.48273942 | 17 | 179.4290596 | 29.26544634 | 16.433 | 85% |
| 268.6083835 | 281.5264 | 2.871486407 | 11.92819449 | 18 | 183.0004099 | 28.03256872 | 16.314 | 87% |
| 568.7582143 | 292.9359 | 1.411081519 | 11.40949233 | 19 | 186.2318426 | 26.93590774 | 16.203 | 89% |
| 1841.487729 | 303.8622 | 0.452079705 | 10.92628372 | 20 | 188.7621549 | 26.12020976 | 16.104 | 90% |
| | | | | 21 | 191.2924672 | 25.30451177 | 16.006 | 91% |
| | | | | 22 | 193.8227795 | 24.48881379 | 15.908 | 92% |
| | | | | 23 | 196.3530918 | 23.67311581 | 15.810 | 94% |
| | | | | 24 | 198.8834041 | 22.85741783 | 15.711 | 95% |
| | | | | 25 | 201.2939557 | 22.08615977 | 15.617 | 96% |
| | | | | 26 | 203.0272286 | 21.56622145 | 15.542 | 97% |
| | | | | 27 | 204.7605015 | 21.04628314 | 15.468 | 98% |
| | | | | 28 | 206.4937743 | 20.52634482 | 15.394 | 98% |
| | | | | 29 | 208.2270472 | 20.00640651 | 15.319 | 99% |
| | | | | 30 | 209.96032 | 19.48646819 | 15.245 | 100% |
| **Average** | 161.8346 | 38.1889 | 14.4696 | 15.0000 | 154.3924 | 37.0973 | 15.9799 | |

# Appendix 12:

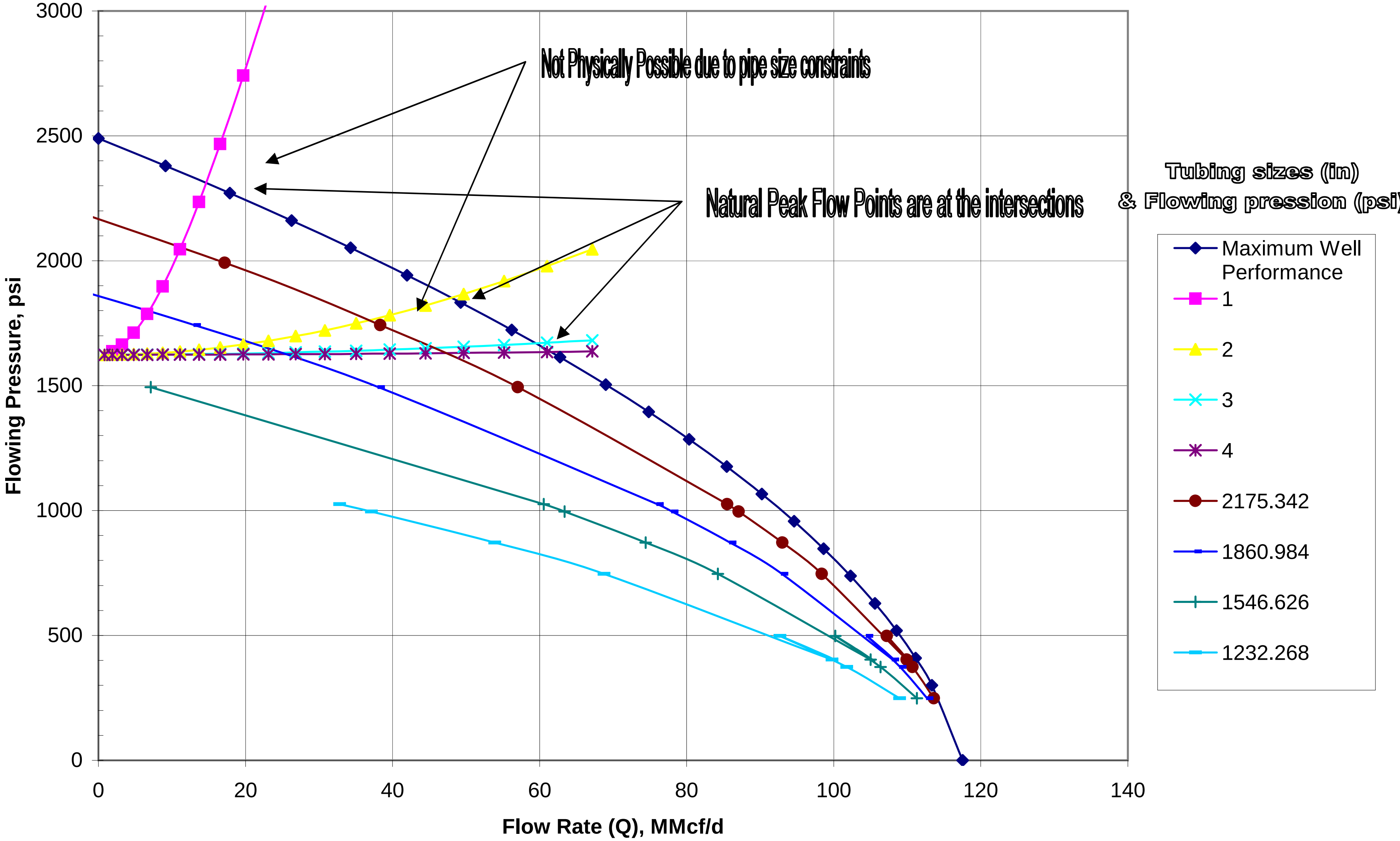
**Tubing Size (in)** 3.00

**Calculated frictional flow data.** / **Interpolated data from calculated data.**

| Time (years) | Cumulative $G_p$ (Bscf) | $q_g$ (MMscf/D) | $G_p$ (Bscf) | Time (years) | Cumulative $G_p$ (Bscf) | $q_g$ (MMscf/D) | $G_p$ (Bscf) | % produced |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0% |
| -0.248997177 | -0.4652 | 5.11896952 | -0.465232271 | 1 | 1.040955777 | 3.075130975 | 1.012 | 10% |
| -0.151433809 | -0.2269 | 4.104808464 | 0.238345796 | 2 | 1.907009158 | 2.646995261 | 1.333 | 19% |
| 0.530404407 | 0.6343 | 3.27618162 | 0.861147401 | 3 | 2.537107856 | 2.430157303 | 1.482 | 25% |
| 2.110154799 | 2.0024 | 2.599834058 | 1.368148168 | 4 | 3.137997495 | 2.239476099 | 1.609 | 32% |
| 5.000813153 | 3.7394 | 2.048639842 | 1.736966656 | 5 | 3.738887135 | 2.048794895 | 1.737 | 38% |
| 9.756696029 | 5.6997 | 1.600513203 | 1.960362347 | 6 | 4.151237927 | 1.95449071 | 1.784 | 42% |
| 17.14847949 | 7.7456 | 1.23746907 | 2.045822136 | 7 | 4.563435283 | 1.860264959 | 1.831 | 46% |
| 28.29558072 | 9.7580 | 0.944824397 | 2.012479344 | 8 | 4.975632639 | 1.766039207 | 1.878 | 50% |
| 44.89988476 | 11.6445 | 0.710531916 | 1.886482848 | 9 | 5.387829995 | 1.671813455 | 1.925 | 54% |
| 69.66737789 | 13.3408 | 0.524636197 | 1.696237874 | 10 | 5.767077279 | 1.588563438 | 1.963 | 58% |
| 107.0997603 | 14.8094 | 0.378839357 | 1.468605289 | 11 | 6.043847039 | 1.539448886 | 1.975 | 61% |
| 165.0648812 | 16.0359 | 0.266161525 | 1.226515416 | 12 | 6.320616799 | 1.490334334 | 1.986 | 64% |
| 258.1385871 | 17.0238 | 0.180680212 | 0.987914136 | 13 | 6.597386559 | 1.441219782 | 1.998 | 66% |
| 415.3837202 | 17.7895 | 0.117333213 | 0.765686691 | 14 | 6.874156319 | 1.39210523 | 2.009 | 69% |
| 700.7664553 | 18.3576 | 0.0717713 | 0.568163708 | 15 | 7.150926079 | 1.342990678 | 2.021 | 72% |
| 1276.808603 | 18.7575 | 0.040249194 | 0.399893321 | 16 | 7.427695839 | 1.293876126 | 2.033 | 75% |
| 2666.04514 | 19.0200 | 0.019545661 | 0.262470902 | 17 | 7.704465599 | 1.244761574 | 2.044 | 77% |
| 7607.460304 | 19.1753 | 0.006905736 | 0.155307424 | 18 | 7.899292346 | 1.215114115 | 2.043 | 79% |
| | | | | 19 | 8.079830703 | 1.188861131 | 2.040 | 81% |
| | | | | 20 | 8.260369061 | 1.162608147 | 2.037 | 83% |
| | | | | 21 | 8.440907418 | 1.136355163 | 2.034 | 85% |
| | | | | 22 | 8.621445775 | 1.110102179 | 2.031 | 87% |
| | | | | 23 | 8.801984132 | 1.083849194 | 2.028 | 88% |
| | | | | 24 | 8.982522489 | 1.05759621 | 2.025 | 90% |
| | | | | 25 | 9.163060847 | 1.031343226 | 2.022 | 92% |
| | | | | 26 | 9.343599204 | 1.005090242 | 2.019 | 94% |
| | | | | 27 | 9.524137561 | 0.978837258 | 2.016 | 96% |
| | | | | 28 | 9.704675918 | 0.952584273 | 2.013 | 98% |
| | | | | 29 | 9.83807153 | 0.934884797 | 2.007 | 99% |
| | | | | 30 | 9.951685617 | 0.920774451 | 2.000 | 100% |
| **Average** | 10.2548 | 1.2236 | 1.0092 | 15.0000 | 6.5157 | 1.4453 | 1.8367 | |

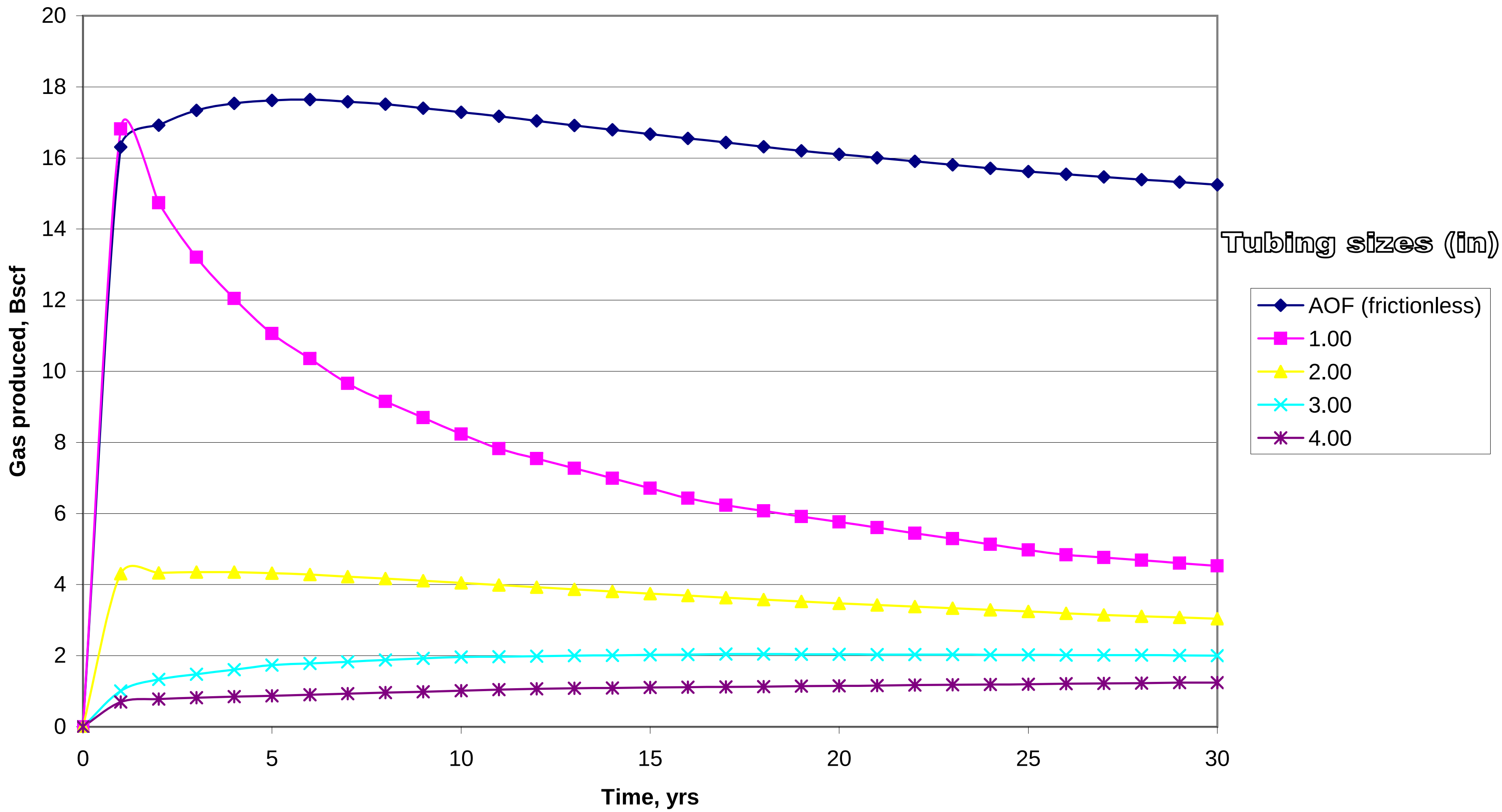
# Appendix 13: Inflow Performance Rate (IPR)

These curves determine the proper tubing size to efficiently drain the gas reservoir.



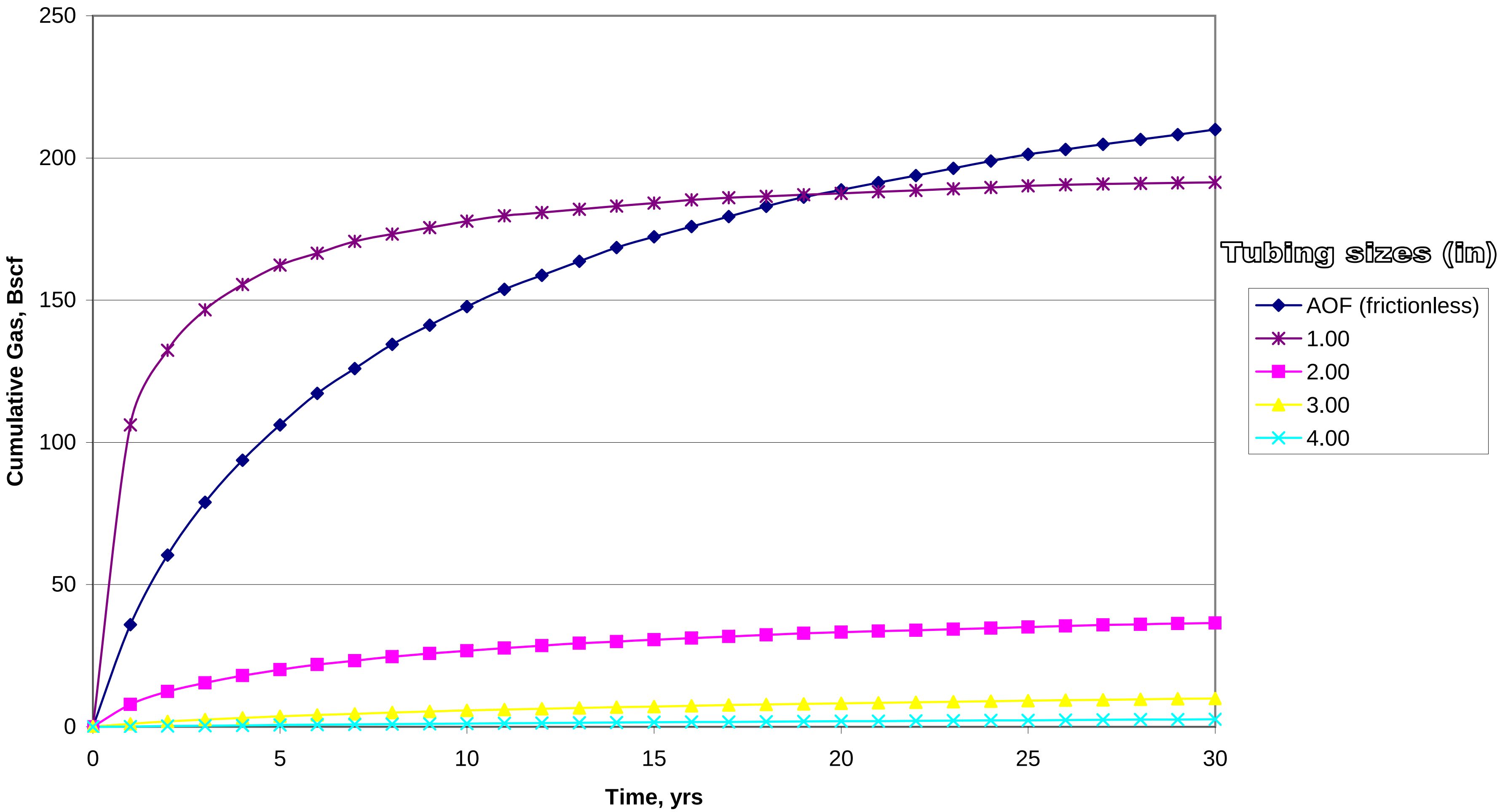
# Appendix 14: Annual Gas Production (Interpolated)

This graph demonstrates the annual amount of gas produced over time which was calculated using the interpolation process from calculated data.



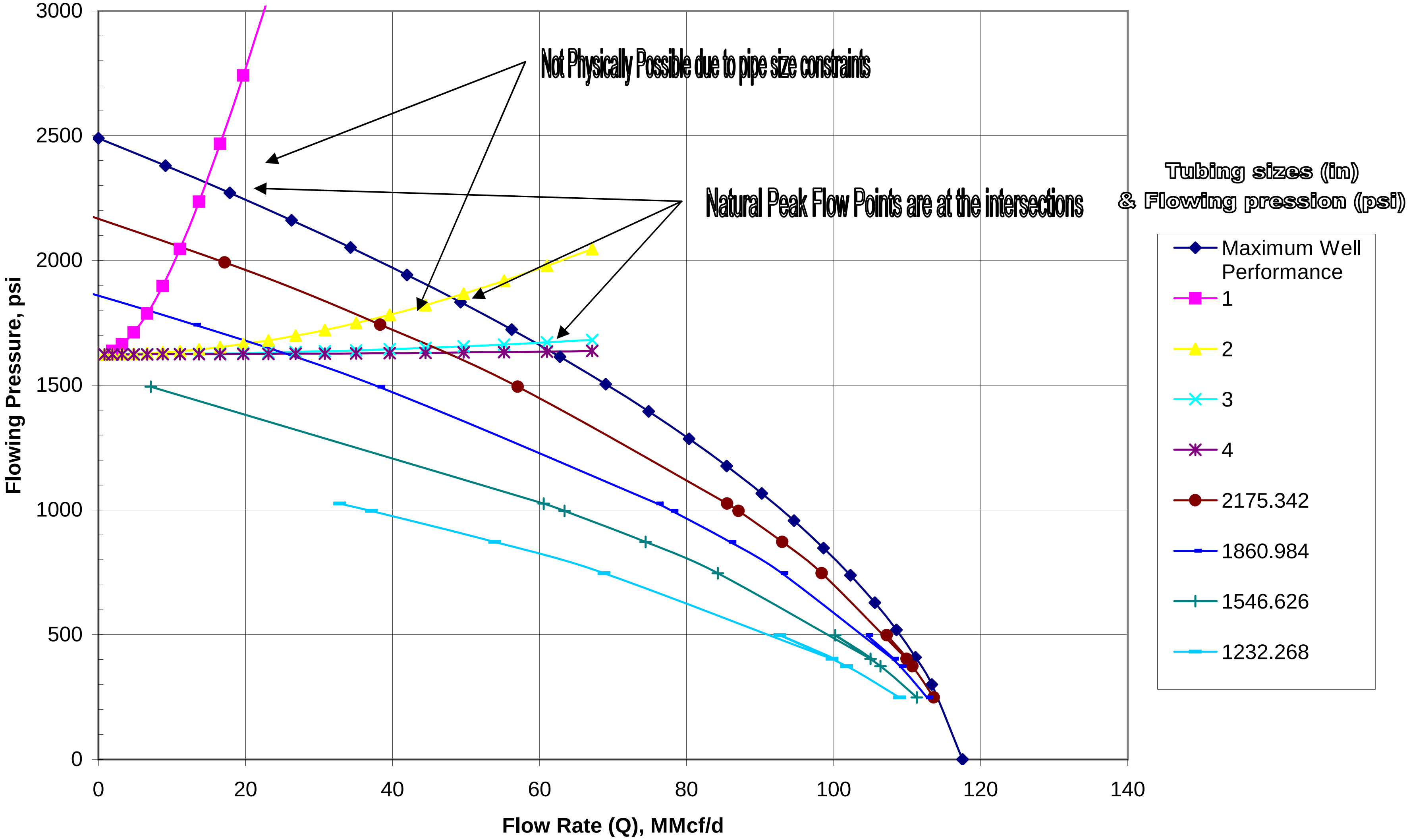
# Appendix 15: Gas Produced over Time (Interpolated)

This graph demonstrates the total amount of gas produced over time which was calculated using the interpolation process from calculated data.



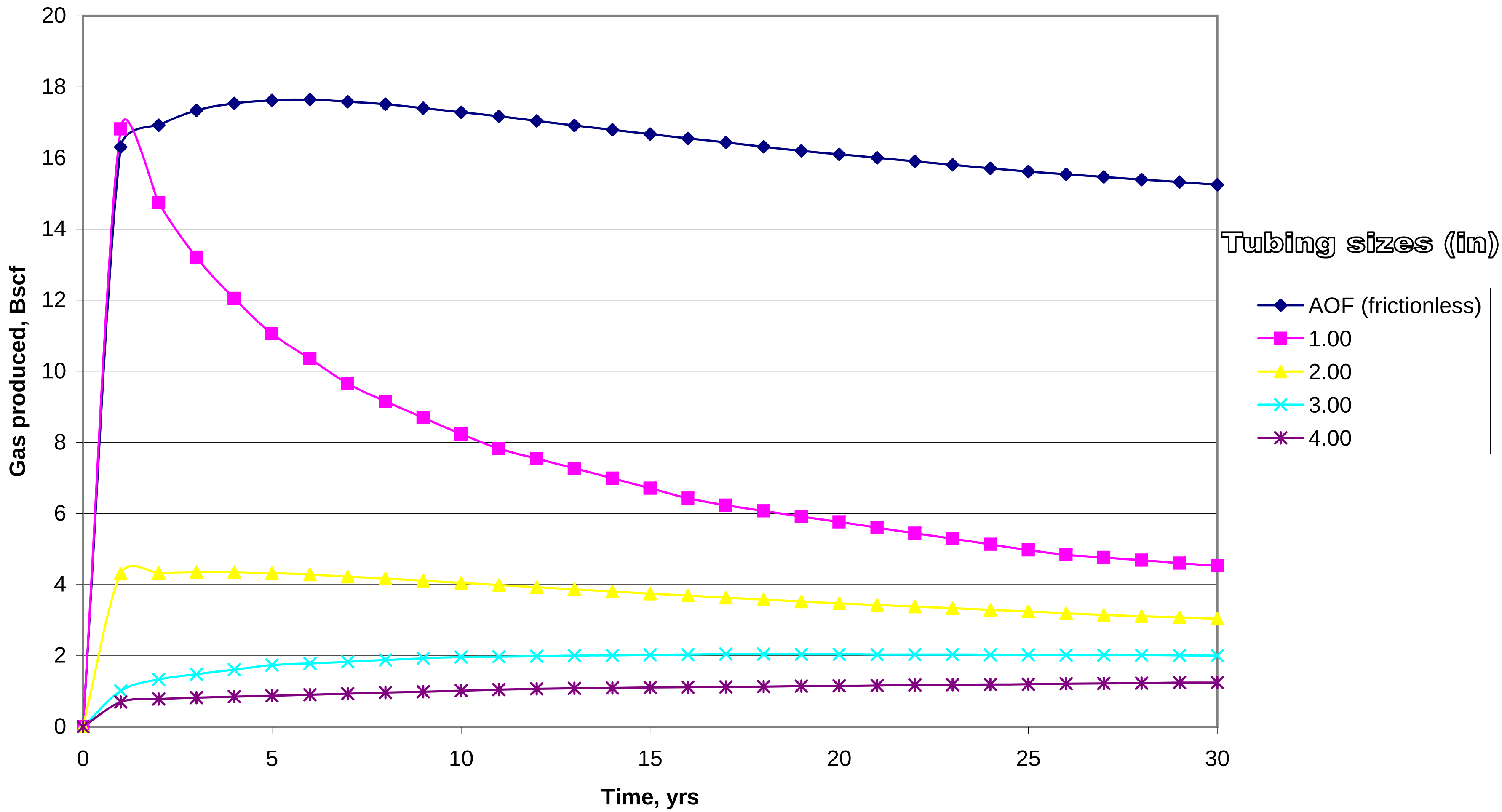
# Appendix 13: Inflow Performance Rate (IPR)

These curves determine the proper tubing size to efficiently drain the gas reservoir.



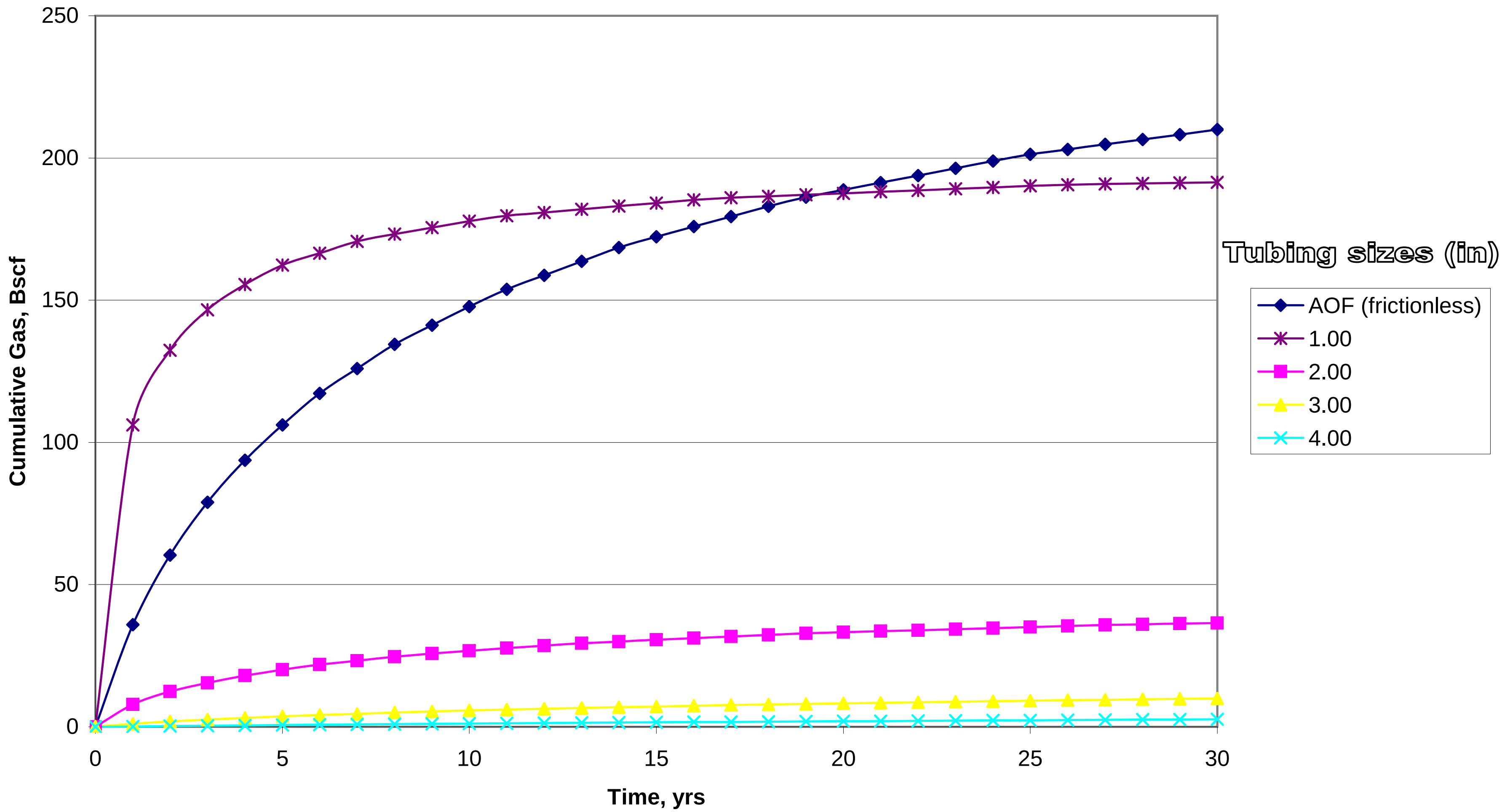
# Appendix 14: Annual Gas Production (Interpolated)

This graph demonstrates the annual amount of gas produced over time which was calculated using the interpolation process from calculated data.



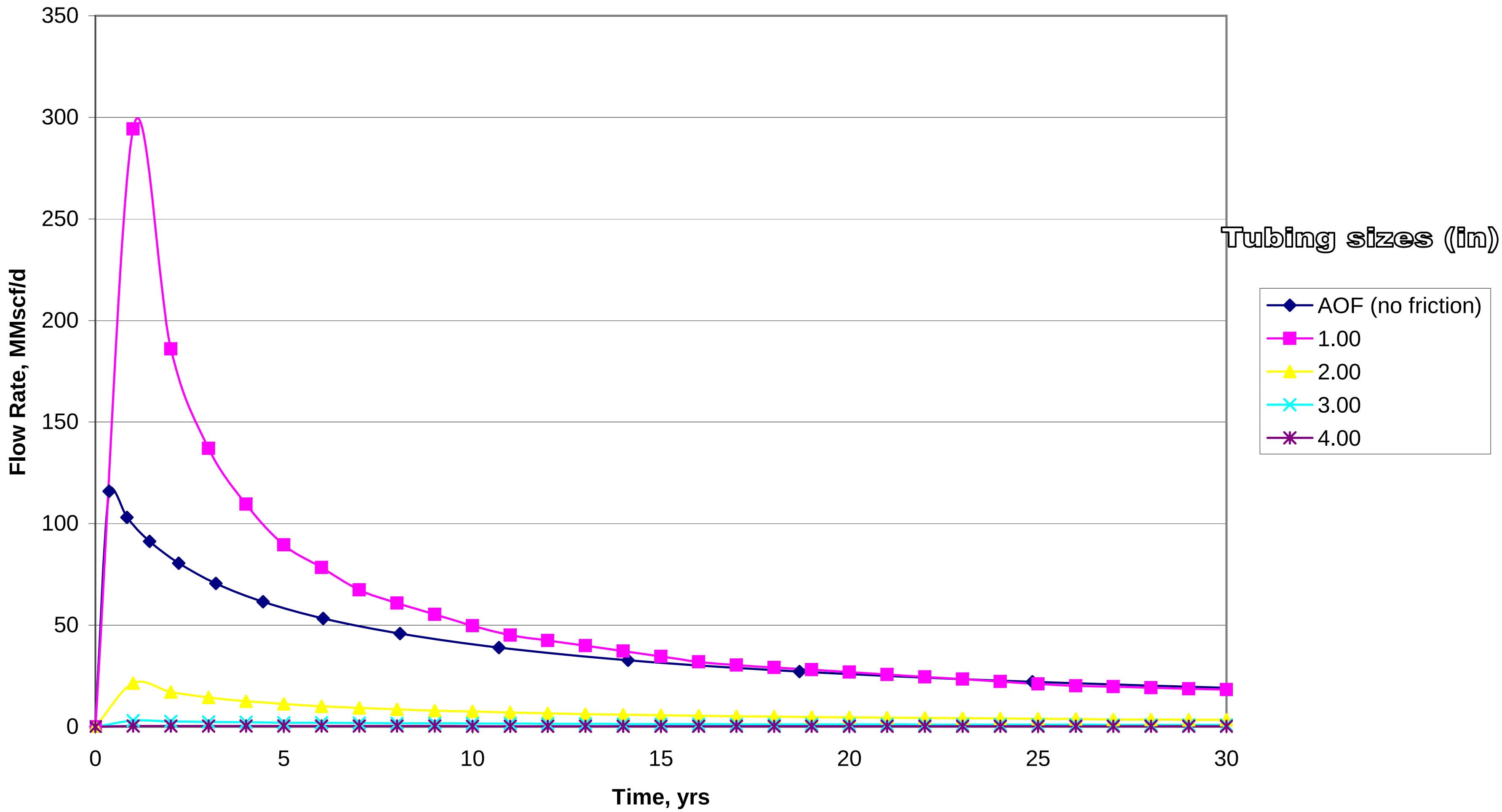
# Appendix 15: Gas Produced over Time (Interpolated)

This graph demonstrates the total amount of gas produced over time which was calculated using the interpolation process from calculated data.



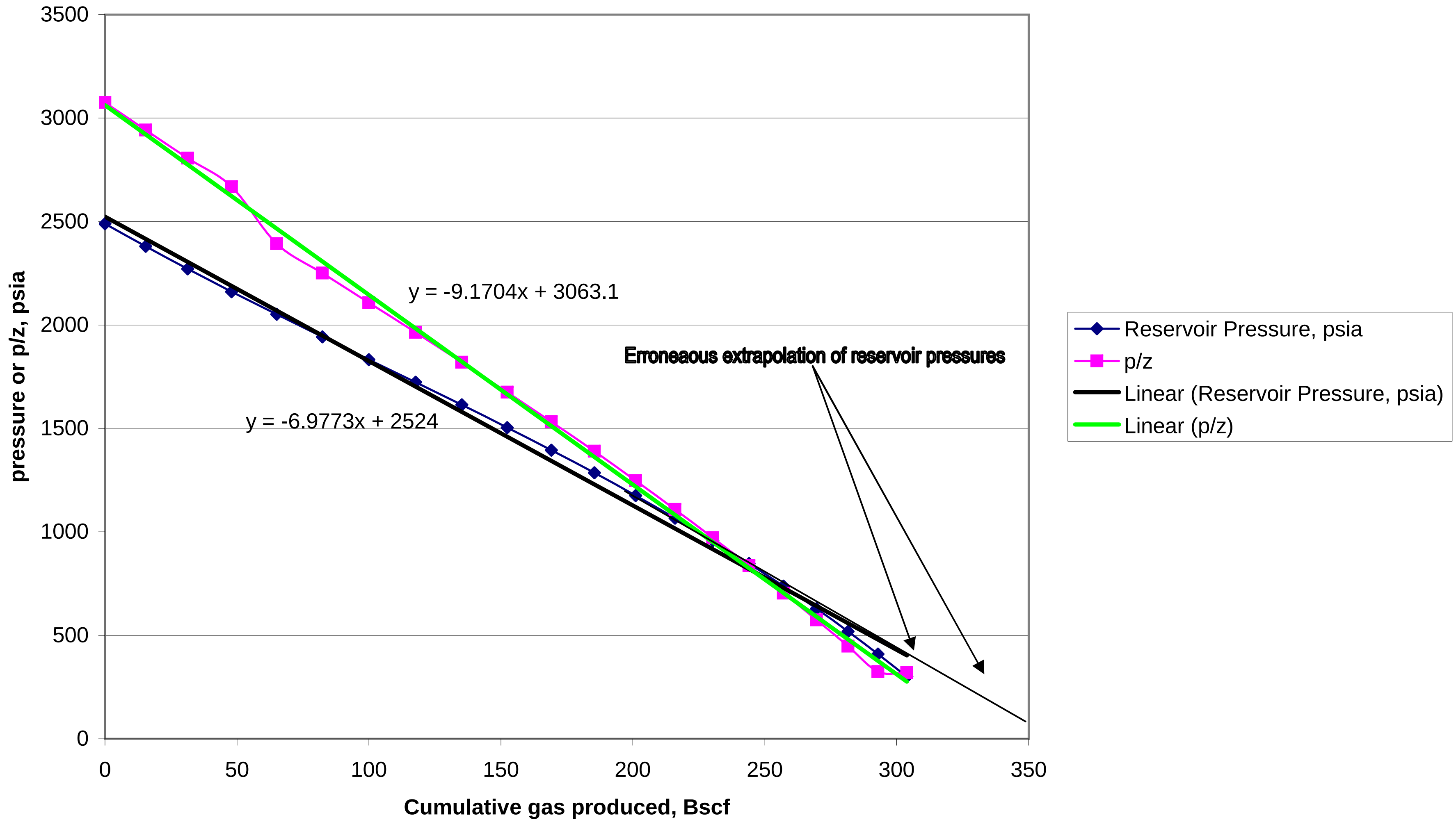
# Appendix 16: Flow Rate vs. Time (Interpolated)

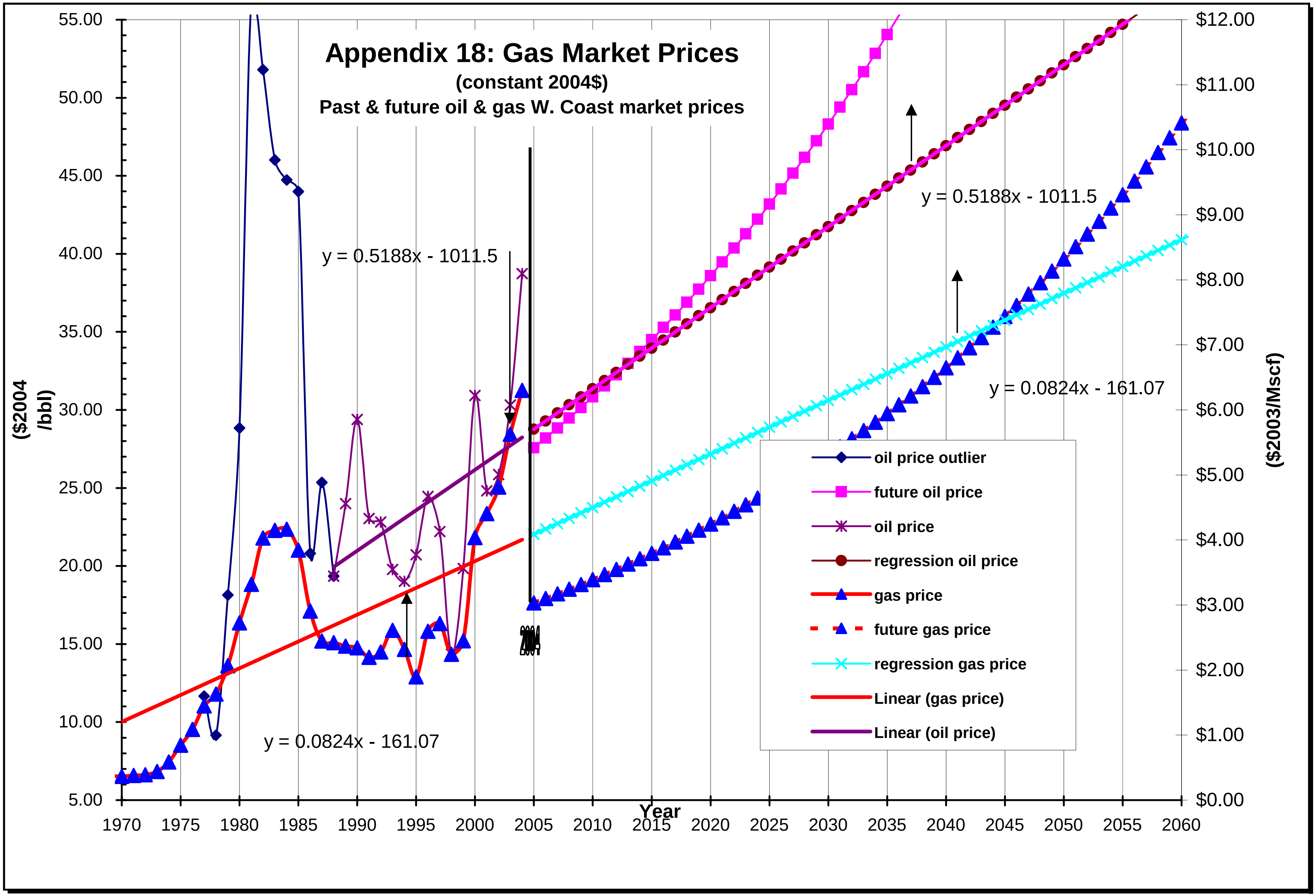
This graph demonstrates the gas rate over time which was calculated using the interpolation process from calculated data.



# Appendix 17: Reservoir Pres. vs. Gas Produced

This graph demonstrates the theoretical ultimate amount of gas that can be produced.




Appendix 18: Gas Market Prices
(constant 2004$)
Past & future oil & gas W. Coast market prices
($2004 /bbl)
($2003/Mscf)
Year
y = 0.5188x - 1011.5
y = 0.5188x - 1011.5
y = 0.0824x - 161.07
y = 0.0824x - 161.07
oil price outlier
future oil price
oil price
regression oil price
gas price
future gas price
regression gas price
Linear (gas price)
Linear (oil price)
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
$12.00
$11.00
$10.00
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
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MARCH 3, 1849