

## Appendix B: Natural Gas Price Forecast Descriptions

BC Hydro has selected five scenarios to represent a broad range of possible future energy market outcomes. For each scenario, there is a matching gas and electricity price forecast

Three third-party gas price forecasts are used: the long-run cost projection from the U.S. Energy Information Administration's (EIA) Reference Case; an industrial consultant, Confer Consulting; and the National Energy Board of Canada's (NEB) Techno Vert Case. These forecasts provide a wide but plausible range of possible outcomes. As well, a high gas price forecast which extends current high gas prices into the future is also modelled. The scenarios are described in detail below:

### B.1. U.S. Energy Information Administration

The Energy Information Administration (EIA) of the U.S. Department of Energy produces complete annual energy forecast, the latest one reported in *Annual Energy Outlook 2003*, published in December 2002.

EIA's forecast is for all forms of energy and is linked to an economic outlook that specifies the rate of economic and population growth. The forecast is produced using substantial modelling resources, with numerical projections generated by the National Energy Modelling System (NEMS). Interactions between the different energy categories are estimated and prices and quantities are forecast simultaneously for all important energy categories including oil, coal, natural gas, electricity and green energy. The macro-economic and policy environment is also considered.

The EIA Reference Case aims to be the most reasonable and comprehensive forecast that can be made on the basis of currently available information. The approach is thorough and relies heavily on modelling. For long-run natural gas prices, a key issue is whether technology and exploration will be able to keep pace with growing demand by finding sufficient supplies and developing them at an economic cost. On this issue, EIA's Reference Case position is that exploration and technology will have difficulty keeping up and that, as a consequence, real gas prices for natural gas will rise steadily in the long run.

The EIA Reference Case has U.S. real GDP growing at a rate of 3.0 per cent per year for the period from 2005 to 2025. For the same period, population grows at an annual rate of 0.8 per cent and the Consumer Price Index grows at 2.9 per cent. Energy intensity (thousands of BTU per 1996 dollar of GDP) declines at the rate of -1.4 per cent per year.

U.S. natural gas consumption in the Reference Case increases at 1.8 per cent per year from 24.60 trillion cubic feet per year in 2005 to 34.93 trillion cubic feet per year in 2025. Consumption of natural gas for electricity generation grows at 3.1 per cent per year over the period to 2025.

Imports of natural gas to the U.S. grow at 3.6 per cent per year from 2005 to 2025. These consist of imports from Canada growing at 2.1 per cent and liquefied natural gas from outside North America growing at 6.5 per cent. While the liquefied natural gas growth is higher, it starts from a very small base and remains well below the level of imports forecast from Canada. The EIA forecast shows new gas supplies from the Mackenzie Delta become significant from 2016 onward, with supplies from Alaska coming in 2021.

The world oil price is projected as \$23.27 (in non-inflated 2001 U.S. dollars) per barrel in 2005 and \$26.57 in 2025.

Current market prices for natural gas are higher than the EIA Reference Case projections. However, current high prices may not be sustained and the EIA forecast is based on long-run supply, demand and technological considerations. Over the period from 2005 to 2025, the Reference Case forecasts real wellhead natural gas prices in the U.S. will rise at a rate of 1.5 per cent per year. This steady increase reflects an expectation of tightening natural gas supplies relative to demand.

The EIA 2003 Reference Case price outlook was higher than the forecast made in 2002, which was in turn higher than the 2001 forecast. The upward trend in forecast prices reflects both the gradual extent of change in any large-model forecasting tool, as well as the steady flow of new information showing continued expectations for demand growth but continued softness in supply response.

## **B.2. Confer Consulting**

Confer Consulting, a Calgary-based firm that has provided services to BC Hydro since 1981, forecasts the lowest gas price scenario among the base cases of the various price outlooks (based on Confer's forecast presented to BC Hydro in December 2002). Its long-run marginal cost (LRMC) of natural gas at the Henry Hub, one of the major North American gas system hubs, increases slowly from \$3.14 (in non-inflated 2002 U.S. dollars) per MMBtu in 2005 to \$3.20 in 2025.

The lower level of Confer's price forecast compared to the EIA is due to Confer's view that demand in North America for natural gas will be lower than forecast by the EIA and that improvements in technology will continue and lower the cost of new gas supply below that forecast by the EIA. Confer states that:

"...reliance on improvements in technology and on demand responses to higher prices result in real future increases in LRMC at modest levels." And, "The challenge in forecasting the longer-term future path of LRMC focuses on the balance between technology and resource location and condition. By forecasting ever-increasing real prices to the end of its forecast outlook in 2025, the AEO concludes that there will not be equilibrium between these forces in the future and that the increase in costs of resource location and condition will, from now on, be such that the benefits of technology improvements will fail to mitigate real price increases. On the other hand, Confer's outlook, and those of other parties that do not have as steep a price increase as the AEO, is based on a more stable balance between these two forces."

The basic analysis performed by Confer is to examine the underlying factors that drive natural gas demand in North America, and then assess the supply potential to meet demand at economic prices. The potential supply is assessed by analyses of the long-run marginal cost of new gas supply; that is, the full cost of investing in and operating new gas supply through its economic life. Several supply sources and technologies are assessed. Strong demand growth expectations for natural gas cause the need to examine the long-run marginal costs of supply from remote areas, such as the Mackenzie Delta; non-conventional technology, such as coalbed methane; and imports of liquefied natural gas.

Confer notes that in the EIA Reference Case, a large fraction of incremental gas supply comes from the Western U.S. where costs have higher historical levels, but where supply has increased significantly in the past several years. Confer sees significant supplies from liquefied natural gas, Mackenzie Delta becoming available sooner than the EIA estimates at costs that are higher than historical supply costs but still economic. Confer forecasts that the Mackenzie pipeline may be built by 2009 and Alaska some time well after 2012, whereas EIA indicates 2016 for Mackenzie and 2021 for Alaska. Confer notes that liquefied natural gas imports have become economic and can be expected to increase supply. Confer estimates the long-run marginal cost of Mackenzie gas delivered to the Alberta AECO hub to be in the range U.S.\$2.15 to \$2.35 per MMBtu. This would correspond to a Henry Hub price of \$3.00 or less, all based on an exchange rate of U.S.\$0.64 per C\$1.00. Confer also stresses that sustained high gas prices will lead to significant demand destruction. The EIA outlook may underestimate this demand effect.

### **B.3. National Energy Board of Canada**

The latest long-term natural gas forecasts of the National Energy Board of Canada (NEB) are in *Canada's Energy Future: Scenarios for Supply and Demand to 2025*, July 2003. The previous NEB forecast was issued in 1999.

Unlike the EIA, which produces scenarios based on massive data sets integrated by means of a large-scale model, NEB sets out two pictures of the future to assess the pace of technological development and the level of action on environmental issues.

The first scenario, called Techno-Vert, is characterized by high action on the environment and a high pace of technological development. The main theme of the Techno-Vert scenario is heightened concern for the environment, leading to environmentally friendly products and cleaner burning fuels. Customers are willing to pay more for these features and prices of energy are higher. While governments assist with research and development program funding, reliance is primarily placed on market solutions. New technologies increase energy supplies and efficiency of utilization. Productivity is high resulting in high economic growth.

In the Techno-Vert scenario, real Canadian GDP grows at a rate of 2.7 per cent per year from 2001 to 2025. Energy intensity declines at the rate of 1.7 per cent per year. The Canadian Consumer Price Index grows at 2.0 per cent and Canadian population grows at 0.6 per cent. Energy demand in Canada grows by one per cent per year. Oil prices are assumed to be a constant \$22 (in non-inflated 2001 U.S. dollars) per barrel for the whole period from 2005 to 2025. This compares with EIA's projection of \$23.27 in 2005 and \$26.57 in 2025.

The NEB Techno-Vert scenario results in natural gas demand being relatively high, because of the clean-burning qualities of natural gas in an arena of enhanced environmental concern. The additional demand puts upward pressure on gas prices, which are uniformly higher than the EIA Reference Case in all of the period from 2005 to 2025. Henry Hub prices in Techno-Vert increase from \$3.53 (in non-inflated 2002 U.S. dollars) per MMBtu in 2005 to \$4.06 in 2025 giving an average growth rate of 0.7 per cent per year. The higher prices increase supply from conventional and non-conventional sources of production.

## B.4. High Gas

Natural gas prices for the year 2003 seem headed to establishing a record high average annual value, estimated in September 2003 to be \$5.29 (in non-inflated 2002 U.S. dollars) per MMBtu at Henry Hub.

This scenario is not based on any model or analytics. The high gas scenario simply assumes that this high market price persists in real terms to 2025. Given the unique set of circumstances that created high prices in the first half of 2003 (low storage and coldest winter in 20 years in the east), and the current supply response, it is unlikely that these prices could persist for an extended period. Therefore, this scenario should not be used on the same basis as the previous three forecasts referenced. The High Gas case should only be used as a “stress test” in performing economic evaluations.

## B.5. Alternative Market Heat Rate

This is a scenario in which the relationship between gas and electricity prices is based on an implied heat rate that is lower than the other forecasts. The market heat rate is the simple ratio between electricity and gas prices, either actual or forecast. This is distinct from a generation plant heat rate, which is an indication of the efficiency of conversion of a hydrocarbon fuel into electrical energy.

The purpose of this scenario is to factor in the sensitivity of the portfolios being assessed to the potential for unforeseen improvements in technology or extraordinary market conditions that might stress the expected relationship between market gas and electricity prices.

This scenario embodies the following possible future outcomes:

- New, more efficient generation technologies;
- Retirements of older plants;
- Market prices not reflecting an all-in fully recovered cost of new generation;
- Regulatory/political market events (such as price caps);
- Effects of generation cross-subsidies and capacity charges; and
- Sustained overbuilds in generation.

The electricity price forecast in this scenario is a product of the gas price and an assumed market heat rate of 8,200 MMBtu/GWh or 8,650 GJ/GWh. This heat rate is comparable to the current market heat rate. This provides a lower market heat rate than the other scenarios and a fundamentally different gas-to-electricity price relationship. By contrast, the market heat rate for the other four gas/electricity price scenarios is in the order of 11,300 GJ/GWh.