

Understanding Residential Electricity and Natural Gas Bills and Prices in Edmonton

2007 September 04

The explanation of electricity and natural gas utility energy bills below relates to Regulated Rate Option (RRO) bills Edmonton. The process of calculating the numbers in this explanation is likely the same or very similar throughout the province.

1. Electricity – Bills, Prices, and Sources

- a) The electricity consumption in a home is due primarily to the number of and behaviour of the people in the home, in how they buy and use their electrical appliances, and only secondarily due to the size of the home.
- b) It is very important to know how our electricity bills are calculated and what are the real prices of electricity so that you know how much money you are going to be saving when you make choices to buy energy efficient lighting fixtures or appliances, or to generate some or all of your electricity by using solar power or wind power.
- c) The average RRO (regulated rate option) consumer price of residential electricity in Edmonton in 2006, with delivery and all fees, was \$10.50 ¢/kWh (the price of natural gas is 3.70 ¢/kWh in comparison). This was 20% higher than in 2005.
- d) In 2006, the price of electricity was an average of 2.8 times more expensive than the price of natural gas. Historically, electricity has been 5 to 7 times more expensive than natural gas. If you waste 38% of your natural gas by using a standard efficiency furnace or water heater, then this makes the energy from electricity only 1.7 times more expensive than the energy from natural gas.
- e) Electricity bills consist of charges from:
 - the company selling the electricity (called the Energy Retailer).
 - You can buy competitive electricity from companies including ENMAX (owned by the City of Calgary), Alberta Energy Savings, and Direct Energy (owned by British Gas). You can buy regulated electricity from EPCOR Energy (owned by the City of Edmonton).
 - plus the company delivering the electricity (called the Wire Service Provider).
 - In Edmonton, the Wire Service Provider is EPCOR Distribution (owned by the City of Edmonton).
 - plus "municipal access fees" (a fee that cities levy to the Wire Service Provider for the right to use city lands to conduct its business), and
 - plus GST.



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f) Electricity bills are made up of a time-based service subscription fee, an electrical energy-based electrical volume fee, and sometimes some "rate riders".

- Your electricity bill = Subscription fee + Energy volume fee
- Subscription fee = Administration charge for selling the electricity plus an electricity delivery infrastructure charge plus GST on these.

This is much like the subscription fee for a magazine. The total subscription fee on your bill has subscription sub-fees embedded in it, and equals one subscription fee for selling the electricity plus another distribution subscription fee for delivering the electricity plus GST on both of them.

The subscription fee pays for the administration of your account, reading your meter, sending out your utility bill, corporate profits, and the construction and maintenance of the electrical distribution system – all of which have fixed costs regardless of whether you use them.

= \$199.75 per year in 2006. This is 10% more than in 2005.

- Energy volume fee = The price of delivered electrical energy multiplied by the amount of electrical energy you used.

This has various energy sub-fees embedded in it made up of the quantity of electrical energy generated, transmitted and delivered plus municipal access fees plus GST.

- Rate riders = There are some new rate riders on our electricity bills, called a distribution true-up rider, transmission deferral rider, transmission true-up rider, and Balancing Pool allocation rider. These can be either fees or credits. They are either time-based or volume-based fees.

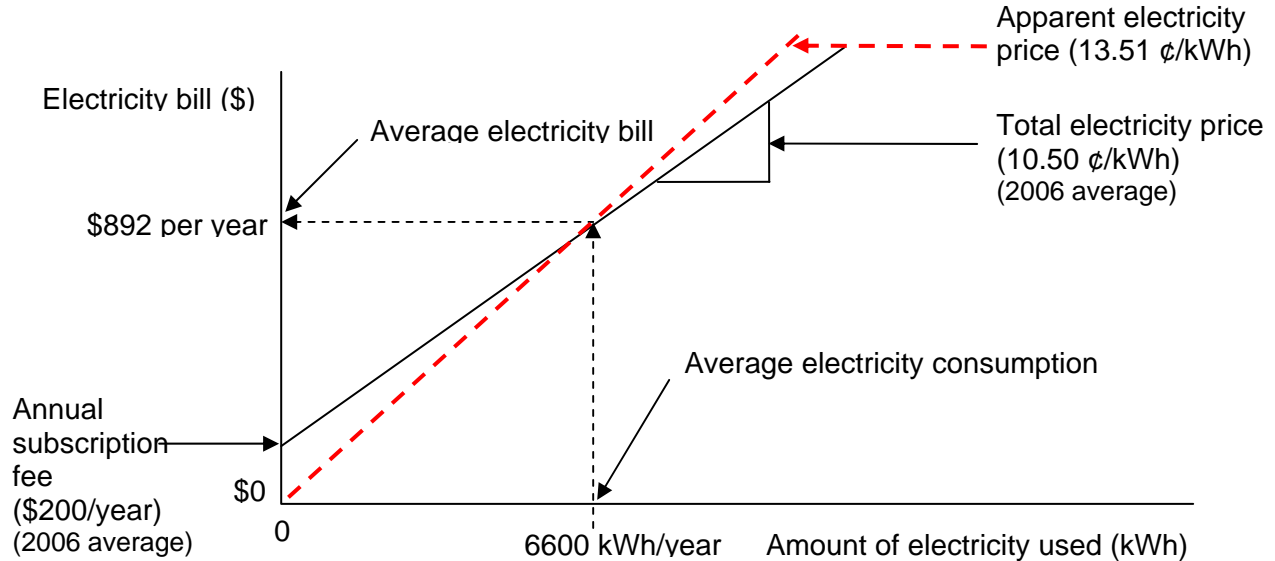
A rate rider is the difference between what the utility company was originally approved to charge by the Alberta Energy and Utilities Board and the amount they now want to charge (also approved by the AEUB).

- Electricity price, delivered = RRO retail electricity price (changes every month but was an average of 8.24 ¢/kWh in 2006)
 - + Electricity distribution delivery price (average of 0.38 ¢/kWh)
 - + Electricity transmission delivery price (average of 0.55 ¢/kWh)
 - + Delivery consumption charge (average of 1.12 ¢/kWh. Was replaced ½ way through 2006 with the above distribution and transmission charges)
 - + Balancing Pool Allocation Rider (0.06 ¢/kWh credit)
 - + Distribution True-Up Rider (0.11 ¢/kWh)
 - + Transmission Deferral Rider (0.07 ¢/kWh credit)
 - + Transmission True-Up Rider (0.21 ¢/kWh credit)
 - + Municipal access fee (0.44 ¢/kWh)(all prices shown as already including GST)
= 10.50 ¢/kWh average for 2006 (This is 20% more than in 2005).



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Figure 1. "Aggregated" Structure of an Electricity Bill



g) Typically, households in Edmonton use an average of 6600 kWh of electricity per year – this varies dramatically with occupant behaviour. With an annual subscription fee is \$200 for EPCOR customers and an average price of 10.50 ¢/kWh, this equals an annual electrical energy cost of \$692 and an electricity bill of \$892. Note that the maximum potential savings by using energy efficiency or solar power systems are \$692, then, unless you go off-grid.

See Figure 1 above for a graph representing the concepts of this. The slope of the sloped line represents the price of electricity. The vertical line is your average monthly or total annual electricity bill. The horizontal line is the average amount of electricity you use per month or the total amount per year in kWh. The amount of the subscription fee is found at the point where the sloped line intersects with the vertical line. If we made a graph to scale with numbers on it, then to find out your average monthly bill or your total annual bill, you would find the point on the horizontal line that shows how much electricity you used, then you would go up to the sloped line and across to the vertical line, where you would read off your bill.

This is the same as the equation below, which you can put into a spreadsheet:

$$\text{Electricity Bill} = \text{Electricity Price} \times \text{Amount of Electricity} + \text{Subscription Fee} \dots\dots\dots \text{Eq. 1}$$

h) Since you pay \$892 for the 6600 kWh of electricity, then it appears that the price of the electricity is 13.51 ¢/kWh (which is \$892 divided by 6600 kWh) (or \$37.53 /GJ). This is the apparent price of electricity – it is what you pay for the energy volume you purchased. Of course there is a lot of other value in our electricity bill, such as the fact that the electricity is always on stand-by ready for us to use it or not whenever we want. The electricity generating company, the transmission company and the distribution company spend huge amounts of effort (which has a big value but which we don't appreciate too much) to make our electricity as safe, reliable and inexpensive as possible.



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i) There are 10 ways your electricity bill can be reduced:

1. The Energy Retailer or Wire Service Provider can reduce the price of their electricity and its delivery;
2. The Energy Retailer or Wire Service Provider can reduce their subscription fees;
3. You can find a cheaper Energy Retailer and buy from them;
4. The municipality can reduce their access fees;
5. The government can subsidise the electricity prices. Note, however:

Subsidies affect the smooth operation of our society; this uses money that could also be used to maintain our infrastructure and making it more energy efficient so that we wouldn't need subsidies.

Subsidies affect economic market forces; they change the price signals that people see. People then they don't take actions based on sound economics, but instead based on government policies (which are easily changed to suit political conditions).

Subsidies affect the environment – they make it appear that the price of electricity is far cheaper than it really is. People then don't take the actions necessary to reduce their electrical consumption and thus reduce the air, land, and water pollution they cause by their use of fossil-fuel electricity.

Subsidies do buy votes – is this the major reason for them being implemented?

6. You can use less electricity by choosing to require fewer energy services (less heating, cooling, cooking, lighting, washing, hospitality, entertainment, laziness and waste);
7. You can use less electricity by switching over your major electrical heating appliances to run on natural gas. (Anything that provides heat uses a lot of energy.) Such appliances would include an electric space heating system (though it is rare to find an electric space heating system), your electric water heating system (this is not common), your electric stove and oven (very common), your electric fireplace (rare) and your electric fridge and freezer (everyone has one or more). Note that natural gas was cheaper than electricity in 2006, though this may be changing.
8. You can use less electricity by using equipment that is energy efficient (which is the cheapest, least risky, and most secure option);
9. You can generate your own electricity from solar PV, microwind, microgas turbines, microhydro, fuel cells (in the future) or Stirling engines (in the future);
10. You can increase your window size and install solar light tubes for more for natural solar daylighting instead of electric illumination.

j) People are usually not clear as to how and where Alberta's electricity is generated. As of 2007 June, Alberta's electricity is generated from:

- Using air to burn coal (mostly in the area of Lake Wabamun)..... 63%
- Using air to burn natural gas..... 31%
- Using water previously stored behind dams on rivers 3%
- Using air to drive wind turbines 1%
- Using air to burn biomass (plant material), biogas (manure), and diesel fuel 0.5%
- Unspecified..... 0.5%



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- Electricity that is lost in the high voltage electrical transmission and the medium voltage distribution wires, transformers and equipment amounts to some 8% of what is generated.
 - Note that Alberta's public air and public waters are free for the electricity generating companies to use. There are no royalties on these public resources that are so necessary for the generation of our electricity. These companies pay no fees to the government to pay for the damage that they cause to these public resources.
- k) Wholesale electricity costs change every 5 minutes or so, according to supply and demand.
- **Supply:** The pricing of electricity depends on its availability.
 - The availability of electricity depends on when electricity generating plants are operating. The availability is reduced (and thus the price is generally increased) when some of the plants are shut down for scheduled maintenance (to make sure that the system is kept at a state of very high reliability), unscheduled maintenance (when equipment malfunctions), and when the power generating companies want to play pricing games to keep the market price high (as is seen in some jurisdictions).
 - Some people say that Alberta's electricity companies participate in “gaming” schemes in Alberta's electricity market. The government has set up the Market Surveillance Administrator to look for this and try and prevent it. See www.albertamsa.ca for more details.
 - Alberta has 11 919 MW of electricity generating capacity as of 2007 June. Our peak usage in the last year was 9 661 MW in November and 9 192 MW in July. On the outside it looks like there is a safety margin of 19%, but this can easily be swept away when plants suddenly break down. Our electricity consumption is growing at a rate of 2.7% per year in 2007, so this 19% won't last long since power plants take several years to gain approval and construct.
 - In 2006, Alberta also imported \$194 million worth of electricity at an average price of 12.7 ¢/kWh and exported \$19 million at an average price of 4 ¢/kWh.
 - **Demand:** The demand for electricity depends on when the customers want to use it and how much they want to use.
 - The electrical customers in Alberta consist of industrial customers (56% of consumption), commercial customers (24%), agricultural customers (3%) and residential customers (16%). In addition, electricity is exported (1% of total) and imported (2%) to and from BC (through a 750 MW line) and Saskatchewan (a 150 MW line).
 - Alberta companies are now building electricity export lines to Montana. This is intentionally designed so that Alberta's electric generating companies can use more of Alberta's cleaner air to burn Alberta's coal to supply America's large appetite for electricity. America gets the electricity but without paying us for its environmental damages. Alberta's citizens get the environmental damage and the health care costs but the benefits from the electricity sales goes to corporations. The air pollution from these plants increases our health care costs, which we alone have to pay for.
 - Our electricity bills only see the monthly results of all these fluctuations. You can look at the Alberta Electric System Operator's Energy Trading System web site <**Error! Hyperlink reference not valid.**> to see these prices.



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- l) **Hidden electricity subsidies:** In generating our coal and natural gas electricity, the coal and natural gas electricity generating companies do not pay a fee for the use of the air and water that they use, contaminate, and discharge into the environment.

The Ontario Ministry of Energy funded a study¹ on what this cost is to society and found that the total cost of generating coal electricity is 16.4 ¢/kWh including environmental and health damages. The cost of the environmental and health damages represents 77% of this, which amounts to 12.6 ¢/kWh. Since 63% of Alberta's electricity comes from coal then 63% of 12.6 ¢, which equals 8 ¢/kWh, needs to be added to our electricity prices in order to appropriately pay for the environmental contamination caused by coal electricity.

Natural gas electricity also has environmental and health care costs. In the same report, the total cost of natural gas generation is 9.8 ¢/kWh, of which the environmental damage is only 2 ¢/kWh. Since natural gas generates only 31% of our total provincial electrical energy, then 31% of 2 ¢, which equals 0.6 ¢/kWh, also needs to be added to our electricity prices.

Thus the price of our electricity needs to rise by 8.6 ¢/kWh from the 10.5 ¢/kWh rate that it is now, to around 19.1 ¢/kWh. This would add \$565 per year to the average household in Edmonton. Because we are not paying this cost in our electricity bills, this then also means that there is now a \$565 per household subsidy on fossil-fuel electricity in Alberta.

Now some people say that this is not a subsidy, however the costs are accruing nonetheless and someone is having to pay it. Certainly the electricity generating companies are not paying for it. What is happening is that we are paying for these health damages, but we are paying for them through our medical care costs where we cannot directly do anything about lowering. Instead the payments for these damages need to come in the form of higher electricity prices. This will be a sustainable and healthy way for Alberta to organise itself. This will give the appropriate price signals to people about the clean production of electricity and the importance of reducing our consumption of this fuel.

Note that these environmental damages do not also include the cost to the health care system of the significant amounts of mercury contamination in the air emitted by the production of coal electricity.

¹ Ontario Ministry of Energy. Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation. 93 pp. See pdf file pages 3, 49, and 59. Prepared by DSS Management Consultants, RWDI Air. 2005 April. This report can be downloaded from (http://www.energy.gov.on.ca/english/pdf/electricity/coal_cost_benefit_analysis_april2005.pdf)



2. Natural Gas Energy – Bills and Prices

- a) The natural gas consumption in a home is due primarily to the size of the home, and secondarily to the number of and behaviour of the people in it and their use of heating appliances.
- b) It is very important to know how our natural gas bills are calculated and what are the real prices of natural gas so that you know how much money you are going to be saving when you make choices to buy an energy efficient furnace or water heater, or to produce some or all of your home heating by using solar heating or geothermal heating.
- c) The average RRO (regulated rate option) consumer price of residential natural gas in Edmonton in 2006, with delivery and all fees, was \$10.27 /GJ (the price of electricity is \$29.17 /GJ in comparison). This was nearly the same as 2005. Winter prices in 2005/06 ranged from \$8.80 /GJ to \$17.85 /GJ before Alberta's government natural gas subsidies. These prices do not include Alberta's 23% natural gas price subsidy because they are based on politically-focussed policies.
- d) In comparison with electricity, in 2006, the price of natural gas was an average of 35% of the price of electricity. Historically, natural gas has been 14% to 20% of the price of electricity. If you waste 38% of your gas by using a standard efficiency furnace or water heater, then this makes the energy from natural gas 57% of the price of the energy from electricity.
- e) Natural gas bills consist of charges from:
- the company selling the natural gas (called the Energy Retailer).
 - You can buy competitive natural gas from companies including ENMAX (owned by the City of Calgary), Alberta Energy Savings, and Direct Energy (owned by British Gas). You can also buy regulated natural gas from Direct Energy.
 - plus the company delivering the natural gas (called the Gas Distributor).
 - In Edmonton, the Gas Distributor is ATCO Gas (traded on the stock market and founded by the Ron Southern family in Calgary).
 - plus "municipal franchise fees" (a fee that cities levy to gas distributors for the right to use the city lands to conduct its business), and
 - plus GST.
- f) Natural gas bills are made up of a time-based service subscription fee, an energy-based fuel volume fee, and sometimes a "rate rider".
- Your natural gas bill = Subscription fee + Fuel volume charge.
 - Subscription fee = Administration charge for selling the natural gas plus a natural gas delivery infrastructure charge plus GST on these.

This is much like the subscription fee for a magazine. The total subscription fee on your bill has subscription sub-fees embedded in it, and equals one subscription fee for selling the natural gas plus another distribution subscription fee for delivering the natural gas plus GST on both of them.

The subscription fee pays for the administration of your account, reading your meter, sending out your utility bill, corporate profits,



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emergency home safety service, and the construction and maintenance of the natural gas distribution lines and system – all of which have fixed costs regardless of whether you use them.

= (Gas purchase administration charge + natural gas delivery infrastructure charge + Municipal Franchise Fee (32%) on the delivery infrastructure charge) x GST.

= \$319.77 per year in 2006. This is 11% more than in 2005.

– Fuel volume fee

= The price of delivered natural gas energy multiplied by the amount of natural gas energy you used.

This has various energy sub-fees embedded in it made up of the quantity of natural gas energy produced, transmitted and delivered plus municipal access fees plus GST.

= Delivered natural gas price x Amount of natural gas used.

– Rate riders

= There are some new rate riders on our bills. These can be either fees or credits. They are either time-based or energy-based fees.

A rate rider is the difference between what the utility company was originally approved to charge by the Alberta Energy and Utilities Board and the amount they now want to charge (also approved by the AEUB).

– Delivered natural gas price

= RRO retail natural gas price (changes a few times a year, annual average of \$8.52 /GJ in 2006)

+ Natural gas delivery price (annual average of \$1.31 /GJ in 2006)

+ Volume-based administration fee (\$0.01/GJ in 2006)

+ Gas rate rider (\$0 /GJ in 2006)

+ Municipal franchise fee (32% on the delivery price and the rate rider, which equals \$0.419 /GJ in 2006),

(all prices shown as already including GST)

= \$10.27 /GJ on average for 2006.

g) Typically, homes in Edmonton use an average of 135 GJ of natural gas per year. The annual subscription fee is \$320 for Direct Energy/ATCO Gas customers. At the average natural gas price in 2006 of \$10.27 /GJ, this equals an annual natural gas cost of \$1386 and a natural gas bill of \$1706. The maximum potential savings are \$1386, then, unless you go completely off the natural gas grid.

See Figure 2 below for a graph representing the concepts of this. The slope of the sloped line represents the price of natural gas. The vertical line is your average monthly or total annual natural gas bill. The horizontal line is the average amount of natural gas you use per month or the total amount per year in GJ. The amount of the subscription fee is found at the point where the sloped line intersects with the vertical line. If we made a graph to scale with numbers on it, then to find out your average monthly bill or your total annual bill, you would find the point on the horizontal line that shows how much natural gas you used, then you would go up to the sloped line and across to the vertical line, where you would read off your bill.

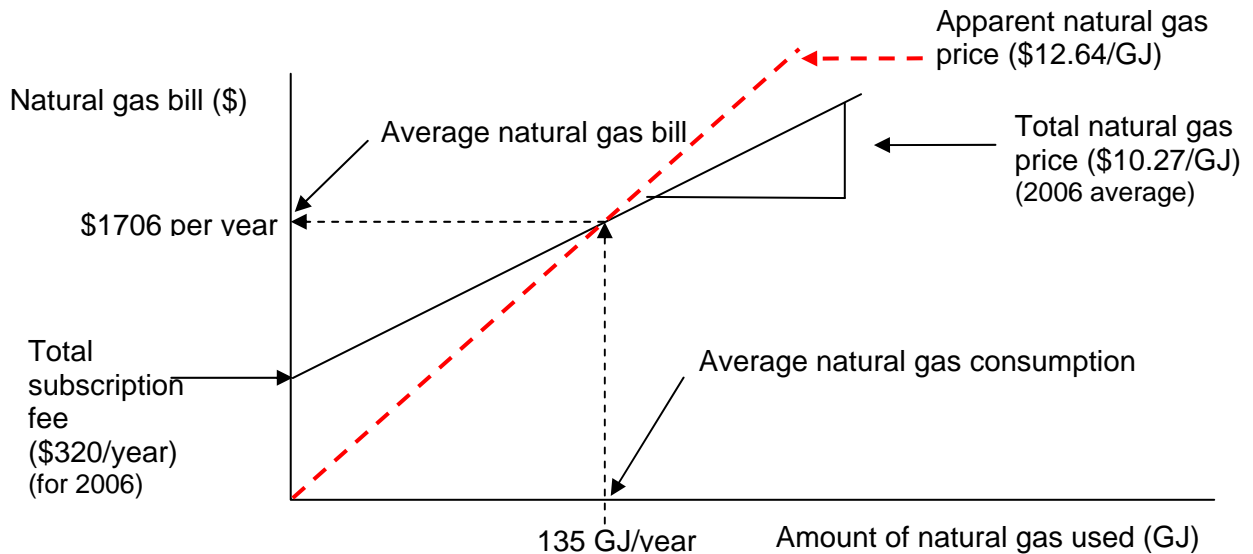


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This is the same as the equation below, which you can put into a spreadsheet:

$$\text{Natural Gas Bill} = \text{Natural Gas Price} \times \text{Amount of Natural Gas} + \text{Subscription Fee} \dots \text{Eq. 2}$$

Figure 2. "Aggregated" Structure of a Natural Gas Bill



- h) All natural gas appliances use most of the natural gas you purchase to provide you with the heating you want. Some of the heat however gets sent up the chimney into the atmosphere. This waste of heat is what is referred to as the appliance efficiency. Typical standard efficiency natural gas furnaces are 62% to 65% efficient – this means that you buy 4 GJ of natural gas at a cost of \$40 and throw it all away, and then you buy another 6 GJ for \$60 and use all of it to heat your house. A medium efficiency natural gas furnace has an efficiency of some 78% to 82%. A high efficiency natural gas furnace has an efficiency of around 92% to 96%.
- i) Since you pay \$1706 for the 135 GJ of natural gas, then it appears that the price of the natural gas is \$12.64 /GJ (which is \$1706 divided by 135 GJ) (or 4.55 ¢/kWh). This is the apparent price of natural gas – it is what you pay for the fuel volume you purchased. Of course there is a lot of other value in our natural gas bill, such as the fact that the natural gas is always on stand-by ready for us to use it or not whenever we want. The natural gas distribution company spends huge amounts of effort (which has a big value but which we don't appreciate too much) to make our natural gas as safe, reliable and inexpensive as possible, including storing it in huge underground salt caverns during the summer for distribution when we want it in the winter.
- j) When comparing natural gas prices to other forms of heat energy or to energy efficiency, it is only useful to discuss the price of the heat being delivered or saved, rather than the price of the natural gas being purchased. So all natural gas prices need to be divided by the efficiency of the gas appliance to find the delivered heat price. For a standard efficiency furnace (62%,



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which is the most common in the province), the delivered natural gas price is \$10.27 /GJ in 2006, which makes the delivered price of **heat** at \$16.56 /GJ (or 6 ¢/kWh). The apparent delivered natural gas price of \$12.64 /GJ then becomes a delivered heat price of \$20.39 /GJ.

k) There are 9 ways your natural gas bill can be reduced:

1. The Energy Retailer or Gas Distributor can reduce the price of their natural gas and its delivery;
2. The Energy Retailer or Gas Distributor can reduce their monthly subscription fees;
3. You can find a cheaper Energy Retailer and buy from them;
4. The municipality can reduce their access fees;
5. The government can subsidise the natural gas prices, which they do every winter, for an annual average of around 23%. Note, however:

Subsidies affect the smooth operation of our society; this uses money that could also be used to maintain our infrastructure and making it more energy efficient so that we wouldn't need subsidies.

Subsidies affect economic market forces; they change the price signals that people see. People then they don't take actions based on sound economics, but instead based on government policies (which are easily changed to suit political conditions).

Subsidies affect the environment – they make it appear that the price of natural gas is far cheaper than it really is. People then don't take the actions necessary to reduce their natural gas consumption and thus reduce the air, land, and water pollution they cause by their use of natural gas.

Subsidies do buy votes – is this the major reason for them being implemented?

6. You can use less natural gas by choosing to require fewer energy services (less space heating, cooking, clothes washing, and showers);
7. You can use less natural gas by switching over your natural gas appliances to run on electricity. Such appliances would include your space heating system (everyone has a natural gas one), your water heating system (most everyone has one), stove and oven (apparently in 5% of households), your fireplace (quite common) and your fridge (rare). Note that electricity is more expensive than natural gas at this time.
8. You can use less natural gas by using equipment that is more energy efficient (which is the cheapest, least risky and most secure option);
9. You can produce your own heat for space heating and water heating from the sun (which is becoming more common) or forest wood (which is not recommended due to deforestation and pollution issues).

Note that all electricity used inside a home degrades into heat and thus helps to heat the home. So when you reduce your electricity consumption, your heating bill will rise. Nevertheless, the increase in the natural gas bill is much less than (about 1/3 of) the decrease in the electricity bill, so you always come out a winner. This is always taken into consideration when calculating the economics of electrical energy efficiency decisions.

l) Wholesale natural gas prices change daily usually rising in the winter and falling in the summer according to demand. This is changing significantly however, because we are exporting 50% of our natural gas to America, and they are using it to generate electricity. When they have a heat



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wave in the summer, then more gas is used and the price rises. The price of natural gas is also affected by demand from agriculture because it is used for making fertilizer.

- Our natural gas bills only see the monthly results of these fluctuations. You can look at the Alberta Energy Company's Natural Gas Exchange web site at (<http://www.ngx.com/marketdata/NGXIAYDIDX.html>) to get an idea of how the prices are fluctuating daily.

All comments and critique on this document are most welcome. Please send your comments addressed to Gordon Howell at ghowell@hme.ca. If you would like, we can e-mail you on request a spreadsheet that will help you clearly identify what is your household electricity and natural gas consumption.

Thank you.

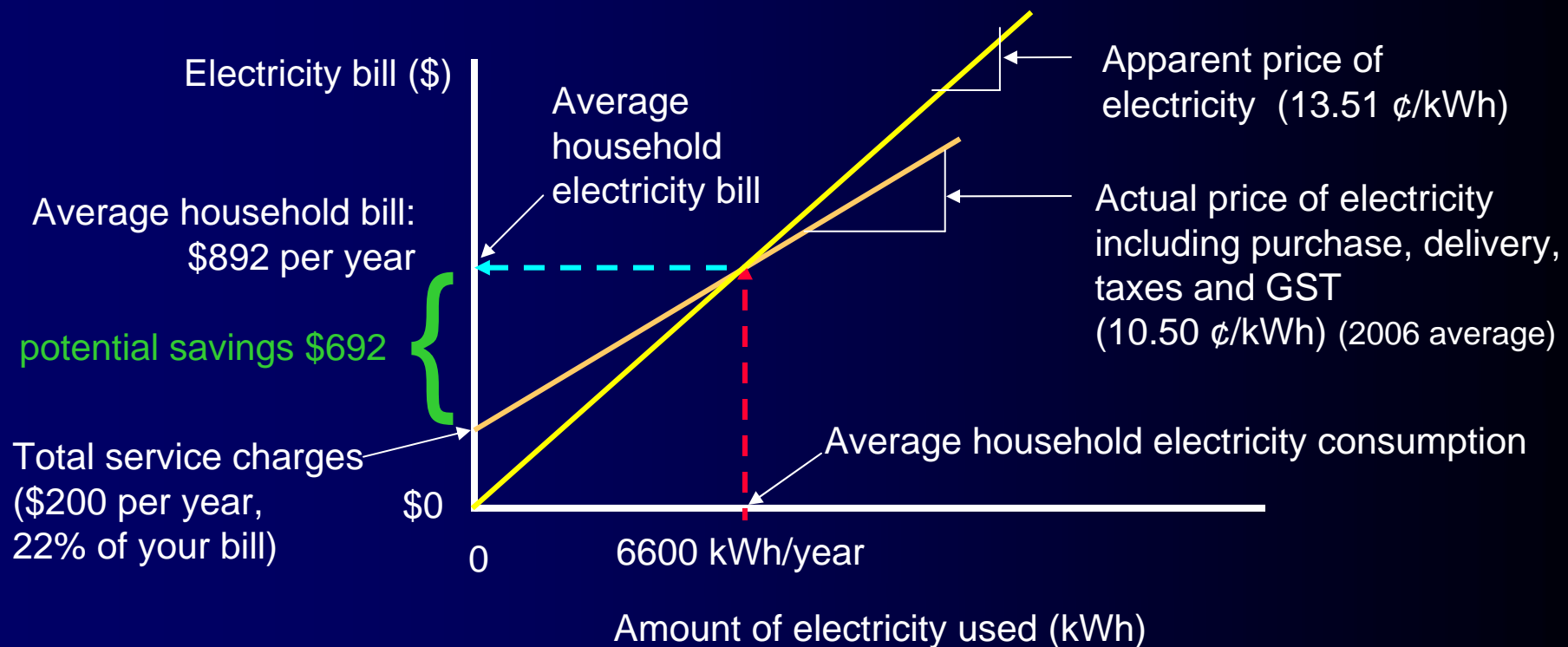
A handwritten signature in black ink that reads "Gordon Howell".

D. Gordon Howell, P.Eng.
Senior Project Engineer

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Electricity Bill (Edmonton)

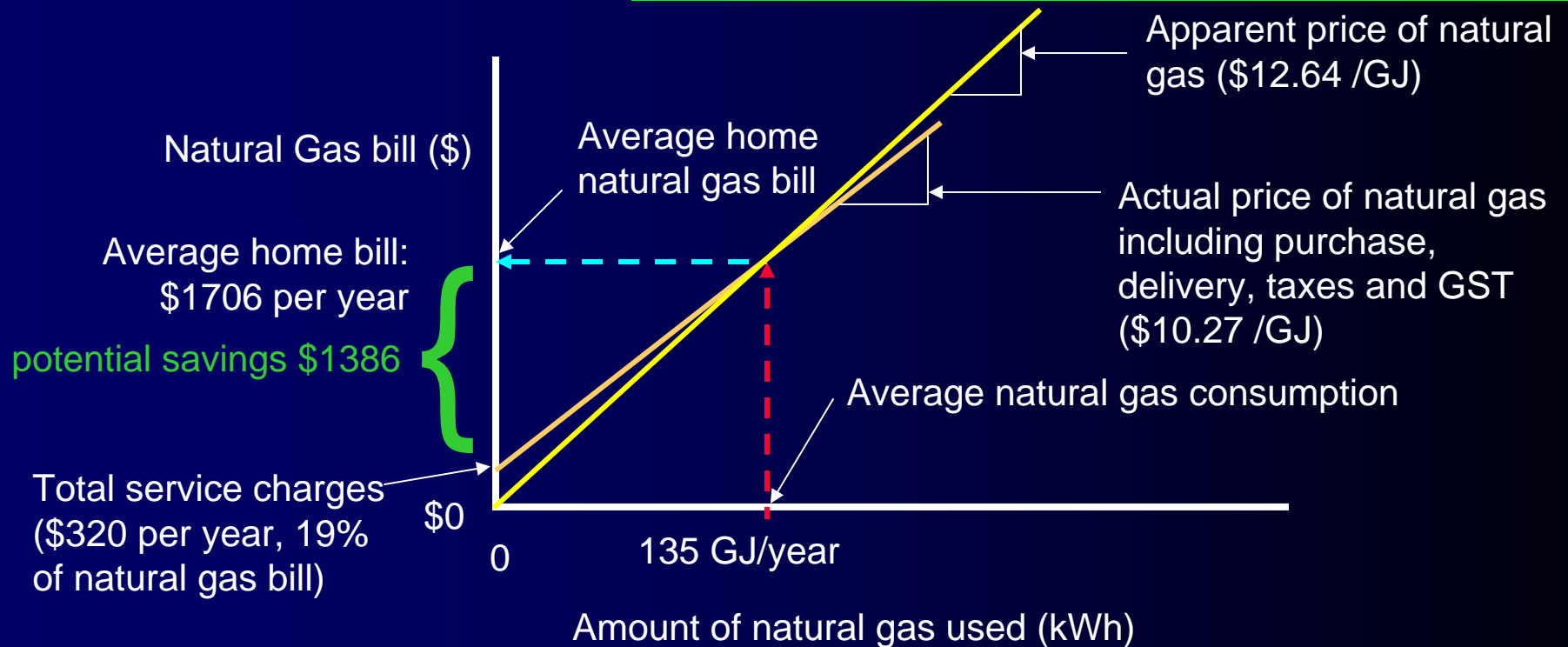
- Subscription fee + energy fee
- Selling electricity, delivering electricity, city access fees, GST
- Energy fee = quantity of electricity purchased and delivered + municipal access fee + GST
- For a typical house, the potential savings are \$692 (78% of your bill) unless you go completely off-grid.



Natural gas price of \$10.27/GJ expressed in ¢/kWh to compare with electricity: 3.70 ¢/kWh

Natural Gas Bill (Edmonton)

- Service charge + commodity charge
- Selling gas, delivering gas, municipal access fees, GST
- Commodity charge = quantity of gas purchased and delivered + municipal access fee + GST
- For a typical house, the potential savings are \$1386 (81% of gas bill) unless you go completely off-grid.



Electricity price of 10.50 ¢/kWh expressed in \$/GJ to compare with natural gas: \$29.17/GJ