Alaska Fuel Price Projections 2011-2030

prepared for:
Alaska Energy Authority

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Contents

Introduction

We generated Low, Medium, and High case fuel price projections for the years 2011-2030 for the following fuels:

- Incremental natural gas in Southcentral Alaska delivered to a utility-scale customer
- Incremental diesel delivered to a PCE community utility tank
- Incremental diesel delivered to a home in a PCE community
- Incremental home heating oil purchased in Anchorage, Fairbanks, Juneau, Kenai, Ketchikan, Palmer, and Wasilla

This memorandum provides documentation of the assumptions and methods that we used. A companion Excel workbook contains the detailed projections.

General methods and assumptions

Base year and time horizon

Our projections run from 2011 to 2030. They are computed and reported in inflation-adjusted year 2010 dollars. We recognize that a "projection" for 2011 is unlikely to match actual 2011 data. However, much of the data that we rely on have only been published through 2010.

Ultra low sulfur diesel premium

We continue to include a five cent additional cost starting in year 2008 for rural areas only, to account for the additional refining costs of ultra low sulfur diesel. This value can be quickly changed within the workbook.

Carbon pricing

The carbon pricing component of the model takes a given assumed price per metric ton CO2, beginning at a given assumed year, and increasing at a given assumed annual percentage per year. Similar to the ultra low sulfur diesel premium, these assumptions are parameters that can be changed in the workbook.

For the High case we have assumed an allowance price trajectory based on the Massachusetts Institute of Technology (MIT) *Future of Coal* study.[1] The MIT group described their "High CO2 Cost" case as a $25 per metric ton CO2 allowance cost measured in 1997$, imposed in 2015 and increasing at 4% (which we increase to 5%) per year above inflation thereafter. We have adjusted the 1997$ for inflation through 2010 and also assumed that the price trajectory begins in 2010 at a lower level that passes through the MIT benchmark in year 2015. The $25 benchmark price converted to 2010 dollars is $33.87.

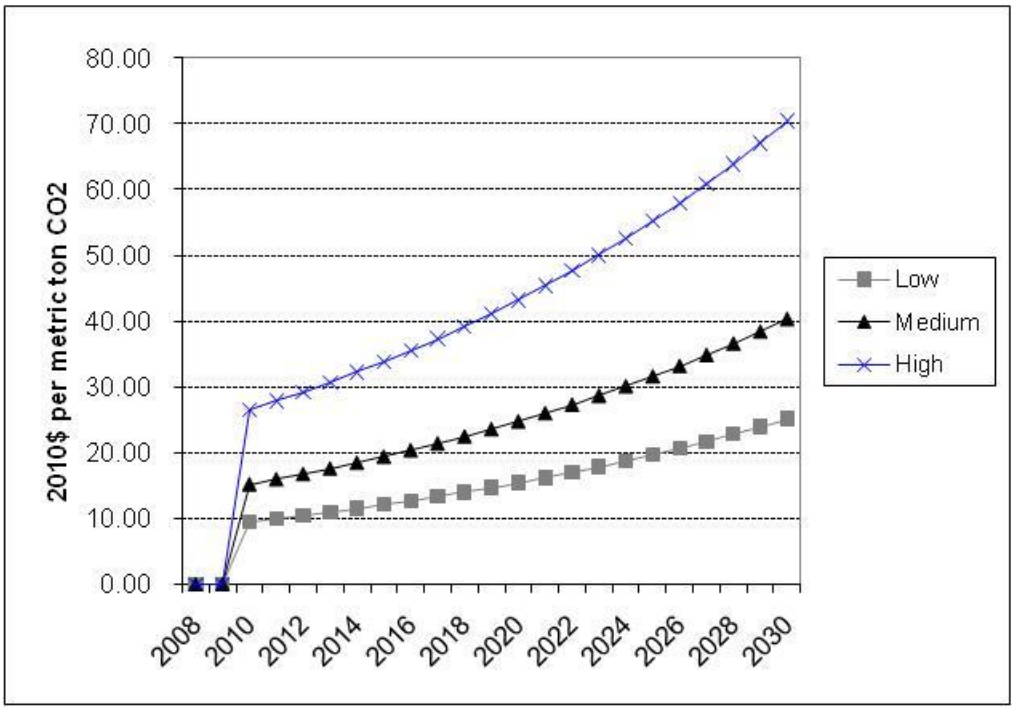
The Low case parameters correspond to the "Low CO2 Cost" case from the MIT study, with $9.48 ($7 in 1997$ adjusted to 2010$) starting in 2010, increasing by 5% per year.

The Mid case is somewhat arbitrarily set in the middle, at $15.20 (2010$) starting in 2010 increasing by 5% per year.

The prices per metric ton are converted to prices per gallon of distillate fuel using the coefficient from EIA (http://www.eia.doe.gov/oiaf/1605/coefficients.html).

Figure 1 summarizes the assumed carbon price trajectories.

Figure 1. Carbon price trajectories (year 2010$ per metric ton CO2)



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[1] Massachusetts Institute of Technology. 2007. *The Future of Coal: Options for a Carbon-Constrained World*. (March). Available at: http://web.mit.edu/coal/

Natural Gas

Background

The Cook Inlet natural gas market is structurally different from the Lower 48 natural gas markets because it is not connected to a large pipeline network and has relatively few buyers and sellers of gas. As a result, Cook Inlet does not have a natural gas spot market to reveal the true market value of natural gas. In Lower 48 natural gas markets, the market value of gas is revealed by market forces as thousands of buyers and sellers bid on natural gas spot markets. Most natural gas used by Lower 48 utilities is not purchased on the spot market but the physical access to spot markets ensures the price utilities pay for gas reflects the true value of the gas. Public utility regulators in these markets generally do not have to regulate the price utilities pay for natural gas because the price is largely determined by local and regional markets.

In contrast, the Cook Inlet natural gas market has no spot market and thus no clear market value. Instead, all natural gas sales are based on indexed prices agreed upon in contracts negotiated between natural gas producers and a limited number of buyers. These contract prices are negotiated between natural gas producers and utilities and may not reflect the true value of the gas because utilities do not actually bear the cost of the gas. Instead the entire natural gas cost is passed onto the utilities' customers who do not directly participate in negotiations. The Regulatory Commission of Alaska (RCA) is tasked with protecting the utilities' customers by ensuring that rates are fair and reasonable. Unlike its Lower 48 counterparts, the RCA must determine what merits a fair and reasonable natural gas price in the absence of a natural gas market price.

Historically, natural gas prices, as determined by RCA approved contracts, pegged the price of natural gas to a basket of Lower 48 price indexes including natural gas, crude oil, and heating fuel. This pricing method resulted in low natural gas prices until recently when a drastic increase in oil prices drove up the price of Cook Inlet natural gas purchased on these contracts.

Cook Inlet natural gas is now becoming relatively scarce, necessitating significant capital investment on behalf of the natural gas producers to meet growing demand. The producers have argued that the return on capital for Cook Inlet natural gas investments needs to be competitive with capital investments in other markets and indicated that they need the Southcentral price to more closely resemble Lower 48 prices. Under this reasoning the Cook Inlet producers, local utilities, and the RCA began to agree to and approve contracts with the Cook Inlet natural gas price indexed to Lower 48 spot prices.[2]

Assumptions

The analysis in this report assumes that Chugach Electric Association (CEA) is the marginal supplier of electricity in Southcentral Alaska. Also, it is assumed that the recently approved

[2] For more information on Southcentral Alaska natural gas prices and contracts, see the RCA website: http://rca.alaska.gov/RCAWeb/home.aspx

supply contract between CEA and ConocoPhillips is the marginal supply of gas for electric power generation.

The concept of marginal supply in this context refers to the most recently purchased energy to supply electricity, not to the energy supply that would first be disrupted or offset in the case of new renewable energy. This is appropriate for forecast prices because the most recently purchased energy is a better indicator of future energy prices than previously purchased energy.

The contract between CEA and ConocoPhillips, filed May 12, 2009 (http://rca.alaska.gov/RCAWeb/Certificate/CertificateDetails.aspx?id=7eefd8ff-1630-4ed0-80f6-59e1aed8e391), states that ConocoPhillips will supply natural gas sufficient for CEA to meet 100% of unmet gas requirements through April 2011, roughly 50% of Chugach's unmet gas requirements from June 2011 through 2015, and about 25% of Chugach's unmet needs in 2016 (Figure 2).

Figure 2. Chugach Electric Association natural gas supply, 2009-2016

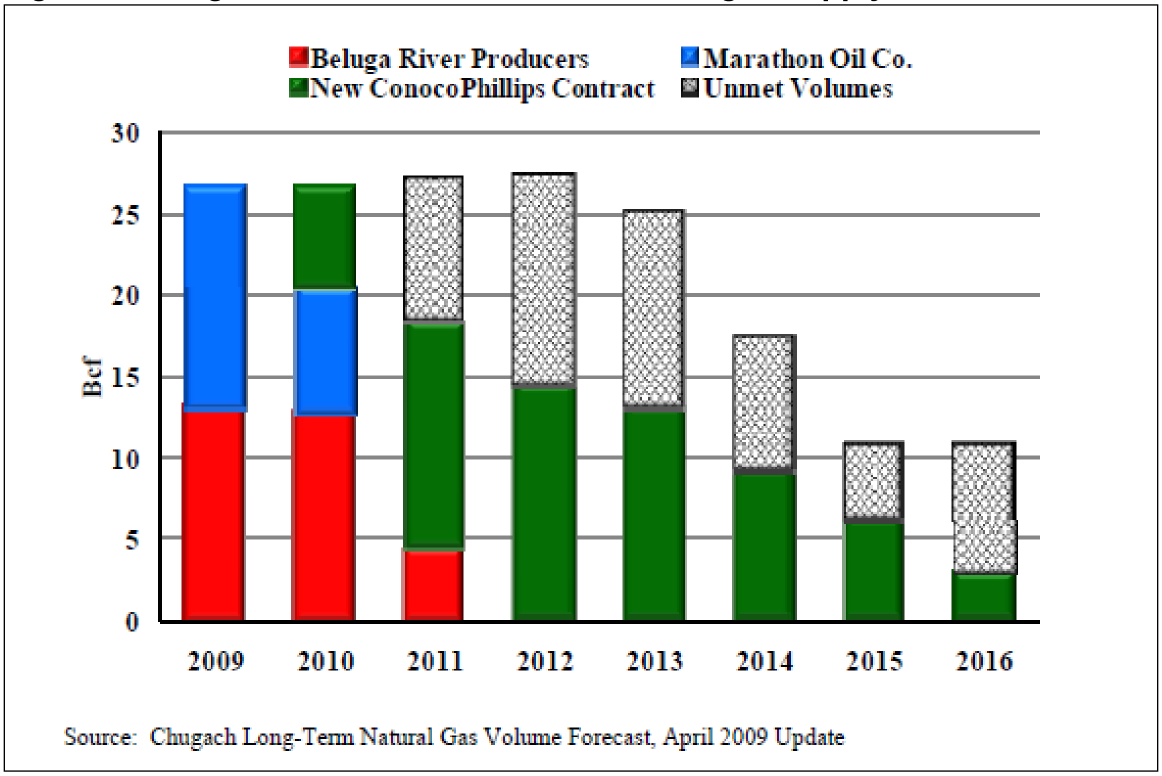


Image reproduced from Chugach Electric Association, Gas Supply Contract with ConocoPhillips, 2009.

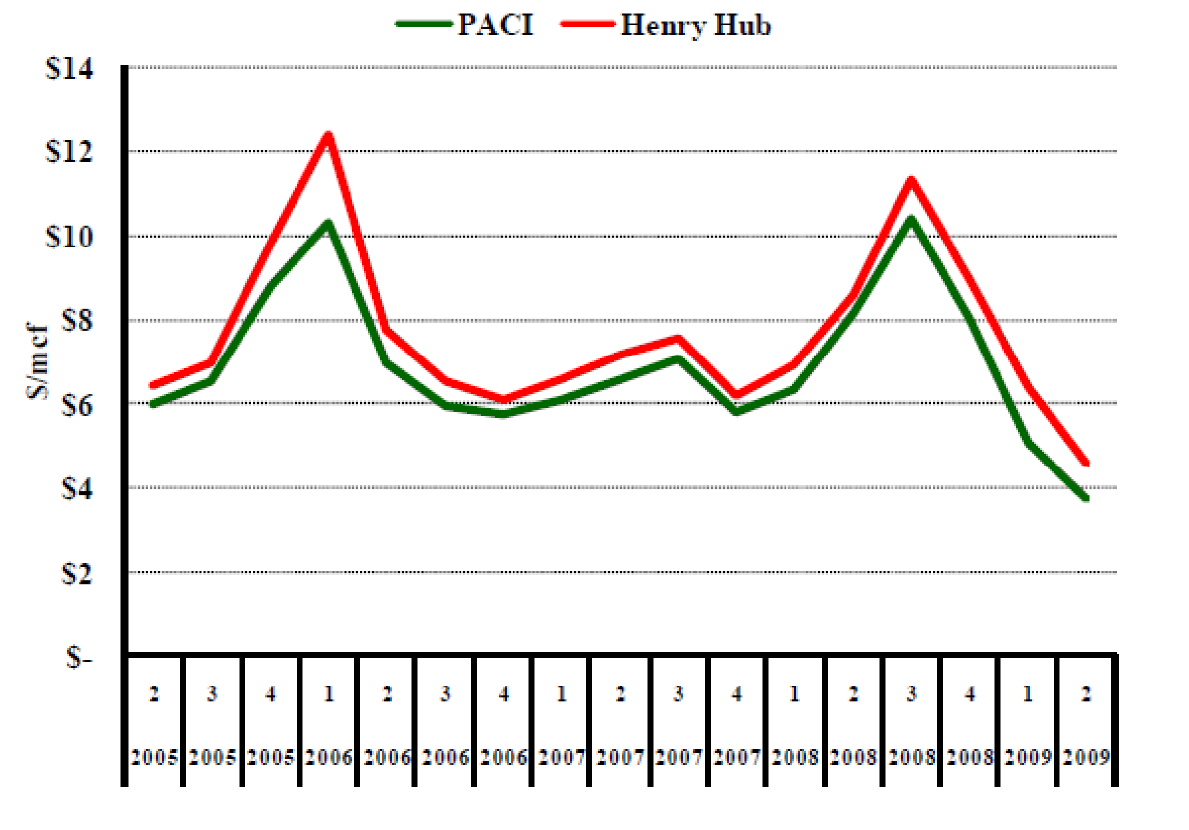
The majority of the gas to be supplied to Chugach Electric Association for base load electric generation is termed "Firm Fixed Gas." The price of this gas is based on an index of natural gas spot markets from natural gas producing areas. This index is termed "Production Area Composite Index," or "PACI." The PACI consists of:

- El Paso, Permian Basin; under the heading Permian Basin Area
- Waha; under the heading Permian Basin Area
- ANR, Oklahoma; under the heading Oklahoma
- Columbia Gulf, Louisiana; under the heading Louisiana-Onshore South

- Agua Dulce Hub: under the heading South-Corpus Christi

In recent history, the price of PACI has been 90% that of Henry Hub[3] and the prices of both have been highly correlated (Figure 3).

Figure 3. Relationship between PACI and Henry Hub natural gas prices, 2005-2009



Source: Platts Gas Daily

Image reproduced from Chugach Electric Association, Gas Supply Contract with ConocoPhillips, 2009.

Forecast

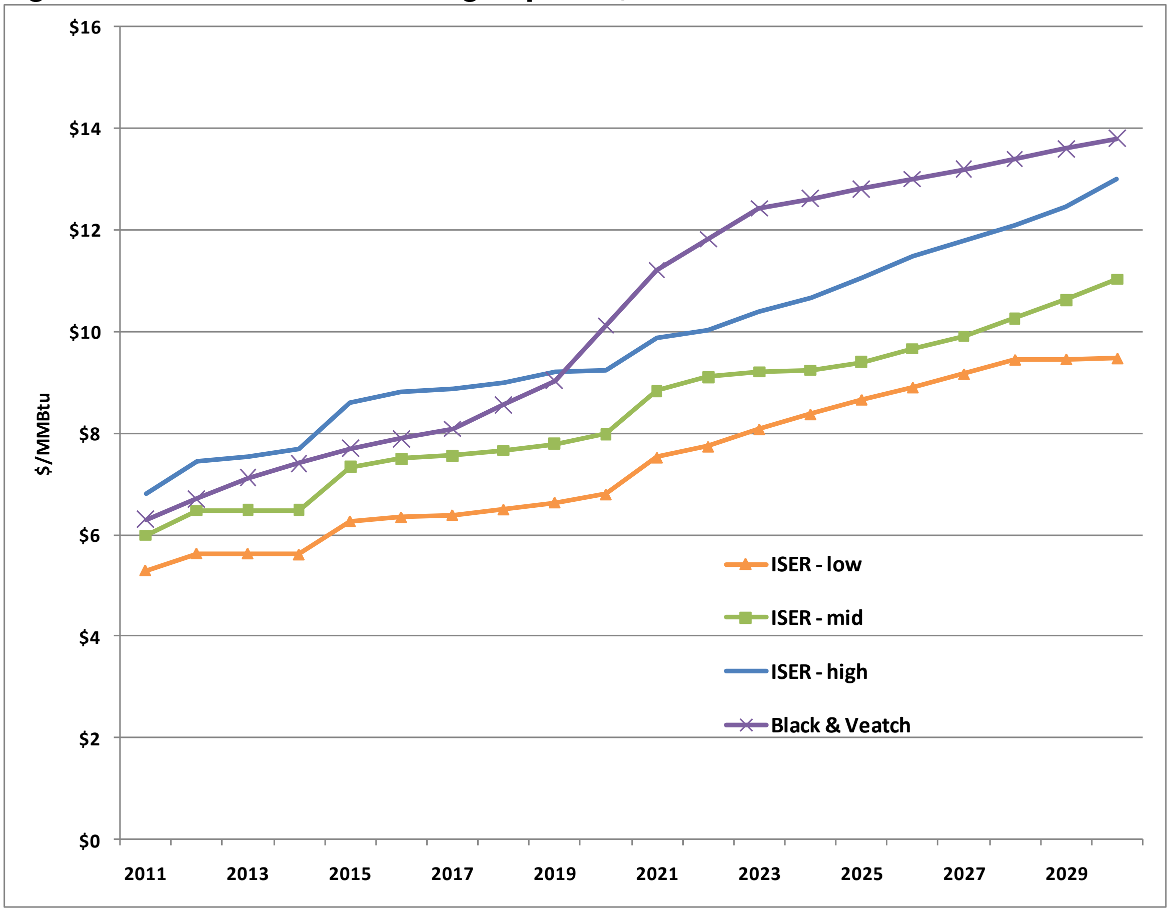
The Chugach contract assumes one mcf (one thousand cubic feet) of natural gas equals one mmBtu (million British thermal units) of natural gas. The Energy Information Administration (EIA) forecasts the Henry Hub price in dollars per mmBtu but the Chugach Electric Association gas is priced in dollars per mcf. In previous forecasts, we used the same assumption that the Southcentral Alaska natural gas price in dollars per mcf equals 90% of the forecast Henry Hub price in dollars per mmBtu. However, given the abundance of shale gas and resulting relatively low recent natural gases prices in lower 48 markets while demand continues to put pressure on Cook Inlet supplies, we do not think this relationship will continue in the long run without a major change in Cook Inlet supplies. To address this decoupling, in this forecast we assume the

[3] Henry Hub is the pricing point for natural gas futures contracts traded on the New York Mercantile Exchange (NYMEX). It is a point on the natural gas pipeline system in Erath, Louisiana.

90% relationship only continues through 2014, becomes 100% in 2015 through 2020, and exceeds by 10% the EIA Henry Hub price forecast from 2021 through 2030.

Despite these changes, this forecast may still be conservative. As a point of comparison, we also show the natural gas price forecast prepared for the Railbelt Integrated Resource Plan (RIRP, see this publication for details on the forecast methodology).[4] Figure 4 shows the forecasted EIA Henry Hub spot price and the calculated Southcentral Alaska gas price based on the formula described above and the RIRP natural gas price forecast.

Figure 4. Southcentral natural gas prices, 2011-2030



Sources: EIA, Report: Annual Energy Outlook 2010, ISER calculations; Black and Veatch, 2010.

Fuel Oil

Background

Fuel oil prices are simpler (although not easier) to project because there are no existing complex contracts with formulas to be followed. Our projections are based on EIA AEO projections of

[4] Black & Veatch, 2010, *Alaska Railbelt Regional Integrated Resource Plan (RIRP) Study*, Final Report, prepared for the Alaska Energy Authority, February 2010.

crude oil. We use the Composite Refiner Acquisition Cost of crude oil (CORAC) as the basis for the fuel oil projections.

Key Assumptions

Assumption 1. The price of diesel to a particular PCE utility bears a stable linear relationship to the RAC crude price, but the coefficient is allowed to be different than 1.0 and is **not** allowed to vary by community. A coefficient above 1.0 indicates "percentage markup pricing" as opposed to a straight pass-through of a crude price increase dollar for dollar.

Assumption 2. We were not able to rigorously determine a home delivery surcharge by statistical methods—there appears to be no consistent relationship between residential home heating fuel prices and crude oil and PCE utility fuel prices. However, the average difference between the 2009 PCE fuel price and Alaska Housing Finance Corporation (AHFC) fuel survey price was $1.00. As a result, we suggest that the community utility fuel price plus $1.00 per gallon be used as the avoidable cost of home delivery when small amounts of home-delivered fuel are being avoided. However, when substantial amount of delivered fuel is avoided (e.g., a community district heating system or mass retrofit for biomass heating), then we suggest that the appropriate credit for avoided delivery charges is zero. The suggested heating fuel premium based on the amount of fuel is shown in Table 1 below. These are the amounts applied in the Renewable Energy Fund project economic review models.

Table 1. Suggested fuel premiums per gallon of displaced fuel

Gallons of Displaced Heating Fuel	Heating Fuel Premium
<1,000	$1.00
1,000 < 25,000	$0.50
25,000 > 100,000	$0.25
>100,000	$0.00
Gallons of Displaced Transportation Fuel	
All	$1.00

Source: ISER fuel price analysis.

Determining the value of an avoided gallon of fuel oil for spacing heating by renewable energy projects is complex because a substantial portion of the costs that ultimately determine the price per gallon of village home heating fuel are fixed. In addition, specific community circumstances, such as whether a bulk fuel storage facility was recently upgraded or will soon need to be, influence actual potential avoided costs; most of the costs of storage and delivery can only be avoided in "lumps." More analysis of community non-utility fuel use and prices will be necessary as more energy projects displace space heating diesel fuel.

We also believe that the relationship between crude, refinery and final community wholesale fuel prices are not well represented in this relatively simple statistical regression analysis when crude oil prices are declining. We hypothesize that this may be the result of a number of factors including: the varying time intervals between the placement of orders, departures of fuel deliveries from refineries, and fuel storage inventories in communities, as well as distances between refineries, fuel distributors and community storage facilities. All of these may contribute to sticky downward movement of fuel prices.

Projection method

The fuel oil price projection is based on the imported crude oil price projection from EIA's Annual Energy Outlook (AEO) updated in December 2010.

1. Obtain EIA's Annual Energy Outlook 2011 Early Release from the following URL: http://www.eia.doe.gov/oiaf/aeo/index.html

2. Obtain the forecast Imported Crude Oil Price from Table 1 for the reference, low price, and high price cases.

3. Obtain the monthly "U.S. Crude Oil Imported Acquisition Cost by Refiners (Dollars per Barrel)" (CORAC) from the following URL: http://tonto.eia.doe.gov/dnav/pet/pet_pri_rac2_dcu_nus_m.htm

4. For each month, convert the crude price from step 3 to 2010 dollars ("real crude price") using the CPI-U for that month and the average CPI-U (U.S. Consumer Price Index for All Urban Consumers, http://www.bls.gov/CPI/) for 2010.

5. Calculate the average real crude price by fiscal year. Divide by 42 to obtain real crude price per gallon.

6. Obtain PCE fuel prices from fiscal years 1981 – 2009. The PCE Statistical Reports for fiscal years 2002 through 2009 can be obtained from the following URL: http://www.aidea.org/aea/programspce.html.[5]

7. Calculate the average CPI-U by fiscal year, and convert the PCE prices to 2010 dollars based on the average CPI-U for that fiscal year and the average CPI-U for 2010.

8. Generate a dummy variable for each community but one (the control community).

9. The dataset on which the regression will be performed now consists of one observation per community per fiscal year, with at least the following variables:

- community
- fiscal year
- real fuel price per gallon
- real crude price per gallon
- a series of (n-1) dummy variables, where n is the number of communities, and the value of the variable is 1 if it corresponds to the community of the given observation, and otherwise 0

10. Perform an ordinary least squares regression with real fuel price per gallon as the dependent variable, and real crude price per gallon and the community dummy variables as the independent variables. The slope for all communities is the coefficient of the real crude price. The intercept

[5] Data from prior years were obtained from Mark Foster (mafa@gci.net).

the each community is the constant term of the regression, plus the coefficient of that community's dummy variable (in the case of the control community, the intercept is just the constant term).

11. Some communities with little or no data require using data from other communities as a proxy. The proxy communities suggested by AEA, listed with the original community first, then the proxy, are as follows:

- **For** Dot Lake: **Substitute**: Tok
- Hollis: Craig
- Klawock: Craig
- Thorne Bay/Kasaan: Craig
- Kasigluk: Nunapitchuk
- Pitkas Point: St. Mary's

Make the following additional substitutions:

- Chignik Lake: Chignik Lagoon
- Klukwan: Kake
- Kobuk: Shungnak
- Napakiak: Napaskiak

Perform these substitutions not by copying data points from the proxy community into the missing slots, but by copying the regression coefficients from the proxy community.

12. Use the slope and intercepts to predict fuel oil price per gallon for each PCE community as a function of Imported Crude Oil Price per gallon from the EIA Annual Energy Outlook Early Release 2011 (Low, Reference, and High cases) for each year from 2011 to 2030, or any assumed crude oil price.

13. The above prices are for utilities. For avoided use of home-delivered fuel, add $0/gallon if a significant amount of fuel is avoided. Add $1.00 if a small amount is avoided (no clear relationship was found between AHFC surveyed home heating oil prices and PCE utility fuel prices, but the average difference was about $1.00). See assumption 2 and Table 1 above for more details.

14. For urban places (Anchorage, Fairbanks, Juneau, Kenai, Ketchikan, Palmer, Wasilla), obtain prices for heating oil from Alaska Housing Finance Corporation's annual fuel price surveys conducted in years 1999 through 2009 (contact ISER or AHFC to obtain this data). Use the average of #1 and #2 heating oil. Where prices are missing, use the price included in the Alaska Food Cost Survey conducted for December (http://www.uaf.edu/ces/fcs/) (there will still be some missing data points).

15. To obtain crude oil prices corresponding to the time frame of the heating oil prices, calculate the average CORAC per gallon for October through December of each year from 1999 to 2009 in nominal dollars.

16. For each place and year, subtract the average CORAC just calculated for that year from the fuel price for that place and year. Put this difference into real 2010 dollars using the same CPI as above. Put the average CORAC numbers in real 2010 dollars as well.

17. For each place, do a linear regression with the price difference as the dependent variable and CORAC as the independent variable, each year being one observation for that place consisting of a fuel-crude price difference and a crude oil price.

18. Use the regression coefficients to predict the difference between fuel price and CORAC for each place and year as a function of Imported Crude Oil Price per gallon (Low, Mid, and High cases) for each year from 2011 to 2030. Add to these the projected CORAC to obtain a projected heating oil price.

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