# Alaska Fuel Price Projections 2013-2035

prepared for:
Alaska Energy Authority

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## Introduction

The Alaska Fuel Price Projections are developed for the Alaska Energy Authority (AEA) for the purpose of *estimating the potential benefits and costs of renewable energy projects*. Project developers submit applications to AEA for grants awarded under the Alaska Renewable Energy Fund (REF) program process. These fuel price projections are used to evaluate the economic feasibility of project applications; economic feasibility is only one of many factors of the project evaluation process. In this report we present the methodology for the seventh fuel prices projection. In addition to their use for the REF review, the Institute of Social and Economic Research (ISER), University of Alaska Anchorage (UAA) uses the projections for other economic research and energy project evaluations.

Economists at ISER have completed six previous Alaska Fuel Price Projections since 2008 (all available at: http://www.iser.uaa.alaska.edu/). The fuel price projections fulfill an important need for price information and are used by many stakeholders in addition to AEA. As a result of their broad use among the public, we expanded what used to be cursory notes on methodology. Our intent is to provide more detailed information to the report's readers and users of the fuel price projections.

### *Projections vs. Forecasts*

The fuel price projections are not price forecasts. Projections are statistical estimates based on a data sample that systematically adjusts the data using statistical estimation procedures. A projection provides an estimate of future values based on a statistical assessment of past relationships under specific assumptions, but they are not a prediction that these specific assumptions will happen. In contrast, forecasts speculate future values with a certain level of confidence, based on current and past values as a 'prediction' of what will happen in the future. In short, projections are based on assumptions but they do not imply the assumptions will happen, whereas forecasts are based on assumptions that represent expectations of actual future events. For example, in our rural fuel price projections for western Alaska villages, we assume that future sea ice patterns will remain similar to previous patterns and will have a similar effect on the cost and timing of fuel deliveries to the region. We do not attempt to forecast when seasonal ice patterns will change, and build that assumption into a forecast of fuel prices under diminished sea ice conditions.

### *The projections*

The Alaska Fuel Price projections are a statistical estimation of potential utility avoided fuel prices from 2013 to 2035, based on historic relationships between utility fuel prices and crude oil prices reported by the U.S. Department of Energy, Energy Information Administration (EIA).[1] These statistically estimated relationships are used to project potential future fuel prices based on EIA's published *Annual Energy Outlook* crude oil and natural gas price forecasts. So in short, the Alaska fuel price projections are based on EIA forecasts. We use the historic relationships between actual crude oil and actual community utility fuel prices to project each community's future fuel prices based on the EIA forecast. The fuel price projections are limited in their applicability to the modeling of project benefits and costs and *should not be considered fuel price forecasts*.

[1] Avoided fuel costs are the marginal cost for a utility to produce one more unit of power. The projections presented in this report are based on the potential fuel prices a utility may have to pay if it needed to produce one more unit of power.

Based on the EIA low, medium and high forecasts, the projections also provide three possible scenarios: low, medium and high fuel price projections. In addition, estimates of the social cost of carbon (previously included as estimates of potential carbon taxes), and a price differential for home heating fuel are provided and are incorporated into the REF benefit-cost model for evaluating potential projects.[2] Previously, a five cents premium for low sulfur diesel was added to the fuel oil price projections in anticipation of the implementation of low sulfur diesel air quality requirements. However, the low sulfur diesel requirement was implemented in 2010; hence recent prices reflect the effects of the rule and a premium is no longer necessary.

The ranges of values between the low, medium (reference), and high projections are based on the assumptions implicit in the EIA oil price forecasts. Readers are encouraged to directly review the EIA *Annual Energy Outlook 2013* at: http://www.eia.doe.gov/oiaf/aeo/index.html

We generated low, medium, high case fuel price projections for the years 2013-2035 for the following fuels:

- Incremental (or next unit purchased) natural gas in Southcentral Alaska delivered to a utility-scale customer
- Incremental diesel delivered to a PCE community utility tank
- Incremental home heating oil/diesel purchased in a PCE community
- Incremental home heating oil/diesel purchased in Anchorage, Fairbanks, Juneau, Kenai, Ketchikan, Kodiak, Palmer, Petersburg, Sitka, Wasilla and Wrangell

This technical report provides documentation of the assumptions and methods used to develop these projections. A companion Excel workbook contains the detailed projections.

## Methods and assumptions

### *Base year and time horizon*

Our projections run from 2013 to 2035. They are computed and reported in inflation-adjusted year 2012 dollars. Because the projections are statistical estimates of annual prices, they may differ from actual prices. In addition, our sample data sets do not include pricing data for 2013. We recognize that a "projection" for 2013 is unlikely to match actual 2013 data. However, much of the data we rely on is published only through 2011 and 2012.

### *Ultra low sulfur diesel premium*

We no longer include a five cent additional price premium for rural areas to account for the additional refining costs of ultra-low sulfur diesel. The low sulfur fuel requirement was implemented in 2010 and recent prices reflect this factor.

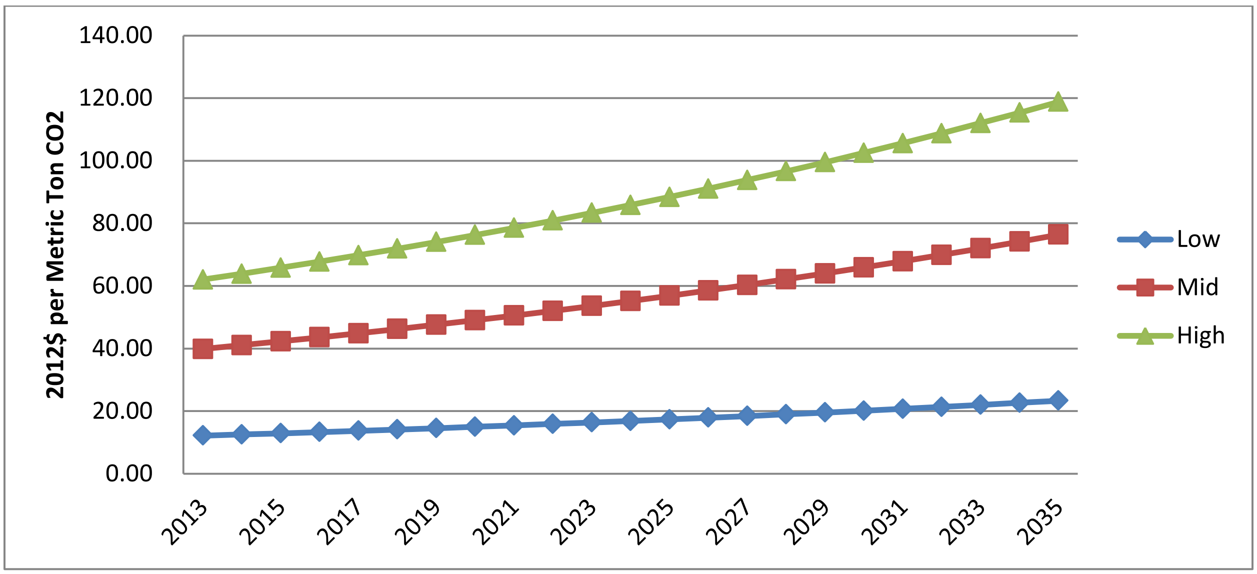
### *Carbon pricing*

We continue to use the federal government's estimates for the social cost of carbon (SCC) that are used in benefit-cost analyses for federally funded projects. In this update, we continue to use the SCC

[2] There are differences in the fuel prices different customers pay. Utilities commonly pay lower prices than retail customers (what a household may pay). Also, there is a difference in the price and cost of fuel used for electricity and fuel used for space heating.

estimates as explained by a working paper from the National Bureau of Economic Research.[3] However, a technical update was published in May 2013 by the Interagency Working Group on Social Cost of Carbon, so we updated accordingly.[4] For the High case, we use the cost of $62 (2012 dollars) per ton of CO2 emissions in 2013. For the Medium case, we use the cost of $40 (2012 dollars) per ton of CO2 emissions in 2013. For the Low case, we use the cost of $12 (2012 dollars) per ton of CO2 emissions in 2013. All three estimates are inflated over time at 3%, which is the average inflation rate of the U.S. Consumer Price Index (CPI) from 1985 to 2012.[5] The carbon pricing methods were modified to reflect current 2012 data. The social cost of carbon is no longer added to the fuel price projections, but rather included separately in the benefit-cost model developed to evaluate proposed projects. However, the flexibility of adding SCC to the price projections remains. Figure 1 summarizes the assumed carbon price trajectories. These assumptions are parameters that can be changed in the model workbook. The data source prior to the June 2011 update was the Massachusetts Institute of Technology.[6]

**Figure 1. Carbon price trajectories (year 2012$ per metric ton CO2)**




Sources: ISER calculations based on Greenstone (2011 and 2013 update).

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[3] Greenstone, M., Kopits, E., and Wolverton, A. 2011. *Estimating the social cost of carbon for use in U.S. federal rulemakings: a summary and interpretation*. NBER Working Paper 16913, available at: http://www.nber.org/papers/w16913.

[4] Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon, United States Government. May 2013. Available at: http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf

[5] Consumer Price Index All Urban Consumers, All items. U.S. Department of Labor, Bureau of Labor Statistics. Available at: ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt. The average CPi from 1985 to 2012 is 2.85%, we use a rounded rate of 3.0%.

[6] In fuel price projections prior to the June 2011 update, the cost of carbon was introduced in the model using the estimates developed by the Massachusetts Institute of Technology (MIT) *Future of Coal* study (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 signals of 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. As a result, the contract prices negotiated between natural gas producers and utilities 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 on to the utilities' customers who do not directly participate in price contract negotiations; the utilities purchasing the natural gas are also not regulated. The Regulatory Commission of Alaska (RCA) is tasked with protecting the utilities' customers by ensuring that rates are fair and reasonable, which they do through review of natural gas contracts. 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 relatively low natural gas prices until dramatic increases in oil prices drove up the price of Cook Inlet natural gas purchased on these contracts.

Over the last few years when Cook Inlet natural gas prices were especially low, there were concerns regarding future availability of Cook Inlet natural gas because significant capital investment on behalf of the natural gas producers would be necessary to meet growing demand. In the past, producers argued that the return on capital for Cook Inlet natural gas investments needed to be competitive with capital investments in other markets and indicated that they needed the Southcentral price to more closely resemble Lower 48 prices to spur continued investments in field development and production. 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.[7]

However, with the sudden rapid increase of shale gas supplies in the Lower 48, natural gas prices dropped significantly. As a result, Cook Inlet became a more appealing natural gas production location given the now relatively higher prices, available infrastructure and ready but less competitive market. This has led to increased exploration and optimism regarding development of Cook Inlet natural gas. In fall 2011, Escopeta Oil company announced that it discovered a large deposit (estimated at 3.5 trillion cubic feet) of Cook Inlet natural gas modifying expectations and assumptions about future Cook Inlet natural gas development and availability. Though there has been no new development in Cook Inlet,

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

exploration has continued and there are positive expectations about future development. However, prices have continued to decrease. Since 2009, when Cook Inlet gas reached its highest average annual price of $7.80 per Mcf (2012$), prices have fallen an average of 11% annually to $4.84 per Mcf in 2013 (2012$).[8] The largest decrease occurred in 2010 when prices dropped approximately 18%.This natural gas projection attempts to take these factors into consideration. Nevertheless, both the national and Alaska markets are clearly in flux and difficult to predict.

### *Assumptions*

As we mentioned earlier, in Alaska the RCA must approve prices and contracts between natural gas suppliers and utilities. Hence, some contract information is publicly available. The analysis in this report assumes Chugach Electric Association (CEA) is the marginal supplier of electricity in Southcentral Alaska. Also, it assumes that two recent contractual relationships provide the marginal supply of gas for electric power generation. CEA fulfills its unmet needs of natural gas through a contract with Conoco Phillips (2009) and a more recent contract with Hilcorp (previously Marathon Alaska Production, LLC) (Figure 2).

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 by a new renewable energy resource. This is appropriate for the projection of prices because the most recently purchased energy is a better indicator of future energy prices than previously purchased energy.

**Figure 2. Chugach Electric Association natural gas supply contracts**

Summary of Chugach Natural Gas Supply Contracts

| Gas Supplier | Contract Term | Contract | Q2-2013 (Actual) | Q3-2103 (Projected) |
|---|---|---|---|---|
| ConocoPhillips | 1/1/2010 – 12/31/2016 | Firm Fixed | $3.44 | $4.08 |
| | | Firm Variable | $4.53 | $4.94 |
| Hilcorp | 4/1/2011 – 12/31/2014 | Firm | $5.94 | $5.94 |
| Hilcorp (Economy) | 4/1/2013 – 12/31/2014 | Base | $7.75 | $7.75 |

Image reproduced from Chugach Electric Association Tariff Advice Letter to RCA No.373-8 from May, 2013.

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 3). Hence, currently and over the next two years, ConocoPhillips will supply CEA with enough natural gas to satisfy 50% of its unmet needs, while the other 50% will be supplied by Hilcorp.

[8] Please note that the 2013 average is partial and only includes two quarters of data. The CI NG average price for 2012 was $5.64 per Mcf.

**Figure 3. Chugach Electric Association natural gas supply, 2009-2016**

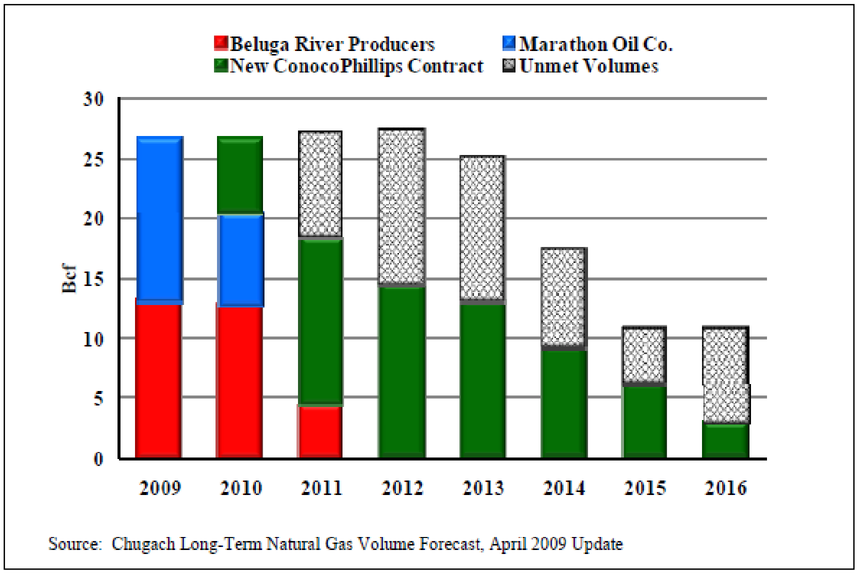


Image reproduced from Chugach Electric Association, Gas Supply Contract with ConocoPhillips, 2009.

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

Until recently, the PACE and Henry Hub prices were highly correlated, the price of PACI was 90% of Henry Hub.[9] However, this correlation changed as a result of the dynamic effects of shale gas development in the Lower 48. The structure of these shale gas markets is still in flux. Although more volatile and less certain, a correlation between PACI and Henry Hub remains since all the producing areas included in PACI and Henry Hub are part of the national natural gas market and they all have been affected by the increase in supply from shale gas.

Furthermore, in 2010 the RCA approved a gas supply agreement between CEA and Marathon Alaska Production, LLC. This agreement allows Marathon to meet 100% of CEA's unmet needs from April 2011 to December 2014. Under this agreement the base price for Firm Gas is calculated using an average of the monthly NYMEX future gas contract prices within a price collar. CEA pays the higher of the two prices which frequently is the floor price. Figure 1 above illustrates the prices CEA expects to pay in the near future under both contracts. Under the Hilcorp agreement Base Gas prices are established at the higher of the annual (or nine months) average of NYMEX future gas contract prices, or the collar floor. Swing Gas is priced at the higher of the collar floor, or 125% of the annual (or nine months) average

[9] 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.

NYMEX future gas contract prices.[10] Excess Gas is priced the same as Swing Gas. Furthermore, natural gas spot and future prices (NYMEX) are based on delivery at the Henry Hub in Louisiana.[11]

In February 2013, Hilcorp Energy took ownership of most of Marathon's Inlet assets.[12] Hence, it is now Hilcorp Energy who fulfills the gas supply agreement.

### *Price Projection*

The Chugach Electric Association contract assumes one Mcf (one thousand cubic feet) of natural gas equals one MMBtu (million British thermal units) of natural gas. The EIA forecasts the Henry Hub price in dollars per MMBtu but the Chugach Electric Association gas is priced in dollars per Mcf, we assume CEA's Mcf-MMBtu conversion factor.

In Lower 48 markets, the abundant shale gas production continues to result in low natural gas prices. Meanwhile demand continues to put pressure on Cook Inlet supplies, though currently supplies remain limited. Still optimism about Cook Inlet supply is growing. After the purchase of Marathon's assets, Hilcorp external affairs manager, Lori Nelson, commented to the Alaska Journal of Commerce that they (Hilcorp) were "confident they can quickly add production" and that they aim to satisfy demand for the coming years. Moreover, Hilcorp stated that they had a 160% increase in gas production in their fields since January 2012.

The major structural changes in both Cook Inlet and Lower 48 markets are impacting our ability to project natural gas prices with high confidence levels. Both of CEA's contracts are indexed or highly correlated to the Henry Hub spot prices. Hence, we assume that over time the overall relationship between the two will stabilize. Our projection takes the Henry Hub EIA forecast as reference and we adjust it upwards by the average price difference between the EIA forecasted price and Hilcorp Firm gas of $5.94 adjusted to 2012 dollars over the projection time period (Figure 4). To establish low and high scenarios, we adjust the modified reference case informed by the CEA's contractual agreements with its suppliers to 90% for the low scenario and 125% for the high scenario.

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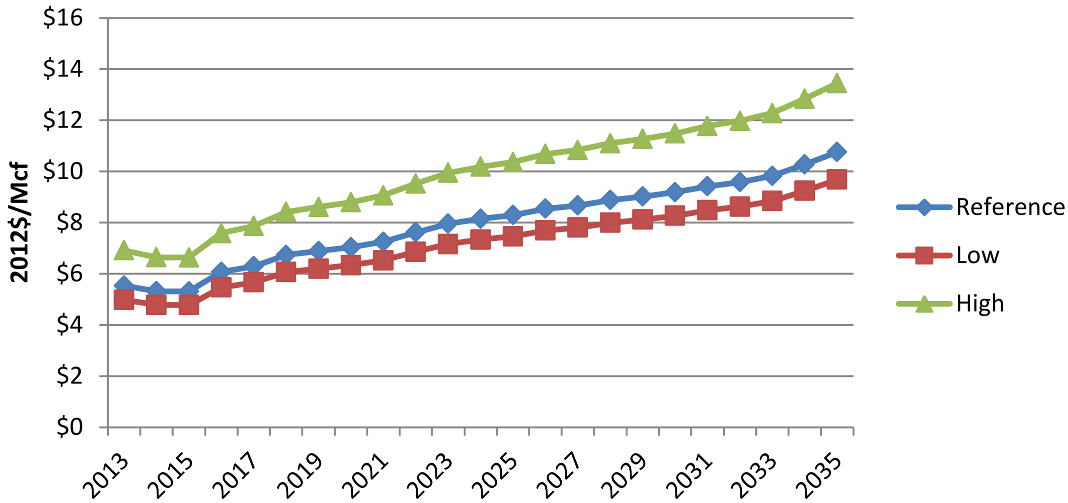
[10] Base gas is gas let in a gas store to provide the pressure needed to produce stored gas, but which itself remains un-produced. Firm gas is gas which a supplier commits to supply to a utility under terms defined in a contract without interruption. Excess gas is either: 1) gas taken at a rate in excess of the daily delivery rate at a premium price; or 2)gas taken in excess to the annual contact quantity. Swing gas, refers to a contractual option where a volume of gas can be supplied between some minimum and maximum limits, and within some defined period at a pre-agreed price.

[11] Official daily closing prices at 2:30 p.m. from the trading floor of the New York Mercantile Exchange (NYMEX) for a specific delivery month.

[12] The fields acquired by Hilcorp include: Ninilchik, Kasilof, Kenai, Cannery Loop, Beaver Creek, Wolf Lake, Trading Bay and McArthur Rivers.

**Figure 4. Southcentral natural gas prices, 2013-2035**




Sources: U.S. EIA Annual Energy Outlook 2012, ISER calculations.

## Fuel Oil

### *Background*

Projecting fuel oil prices requires a different methodology because there are no existing complex contracts that must be approved by RCA. Each utility negotiates individually (or as a group with other utilities or communities) with various fuel suppliers that compete for their business. Our projections are based on U.S. EIA *Annual Energy Outlook 2012* forecasts for crude oil. We use the Composite Refiner Acquisition Cost (CORAC) of crude oil as the basis for the fuel oil projections.

### *Rural Fuel Prices*

This projection update follows the same methodology as the projection update of July 2012 with some improvements. Please refer to Appendix A for added detailed methodology.

The rural regression model assumes that the price of diesel[13] to a particular utility receiving Power Cost Equalization assistance bears a stable linear relationship to the refiner acquisition cost of crude price. In the projections prior to June 2011, parameters were calculated using a pool regression where the coefficient was allowed to be different from 1.0 and **not** allowed to vary by community.[14] A coefficient above 1.0 indicated "percentage markup pricing" as opposed to a straight pass-through of a crude price increase/decrease dollar for dollar.

In contrast, in the current update (and the previous two versions) we ran individual linear regressions for each community, which provides a unique slope and intercept for each community that represents how communities are affected differently by crude oil prices. For example, access to purchased fuel is affected by each community's geographic location; meaning, some communities have more frequent deliveries of fuel than others. To build a more accurate projection, in the June 2011 update we ran two sets of regressions for each community. In one projection, we lagged the crude oil price by one year, while in the other no lag was allowed. The testing of the potential of lagged prices to better explain

[13]PCE prices collected from PCE statistical reports.

[14] Fay, G. and Saylor, B. 2010. *Alaska Fuel Price Projections 2010-2030*, Available at: http://www.iser.uaa.alaska.edu/Publications/oil_price_projection_aea07_2010_v1.xls

some community utility fuel oil prices was based on our research on "components of rural fuel prices" that we completed from 2008 through 2011.[15]

Informed by the regressions, we analyzed which community fuel prices were better explained with a year lag versus those that were not. We used the R-squared and P-values, statistical indicators of the precision of the regression equation's ability to "explain" the historic data, to select the intercept and slopes for each community appropriately. As expected, the scenario without a lag in crude prices better explained the crude and fuel price relationships for communities in the Southeast, Southcentral and Southwest regions where communities have more flexibility in sourcing their fuel and can purchase fuel more frequently. As anticipated, the lagged crude price better reflects the fuel prices for most rural PCE communities where importing fuel is complicated due to their remoteness, and seasonal conditions such as winter sea ice, which permits only one or two fuel deliveries per year. Thus, crude oil price changes have a lagged effect on these communities. Based on that analysis, in the current update, regressions with and without a year lag were run accordingly. The communities that were subject to the No-Lag regression are:

**Table 1. Communities that did not show a lagged relationship to crude oil prices**

| Community ID | Community Name | Census Area |
|---|---|---|
| 14 | Craig | Prince of Wales-Hyder (CA) |
| 28 | Hydaburg | Prince of Wales-Hyder (CA) |
| 65 | Skagway | Skagway |
| 73 | Tok | Southeast Fairbanks (CA) |
| 95 | Chalkyitsik | Yukon-Koyukuk (CA) |
| 103 | Cordova | Valdez-Cordova (CA) |
| 150 | Pelican | Hoonah-Angoon (CA) |
| 151 | Perryville | Lake and Peninsula |
| 159 | Saint George | Aleutians West (CA) |
| 175 | Unalaska | Aleutians West (CA) |

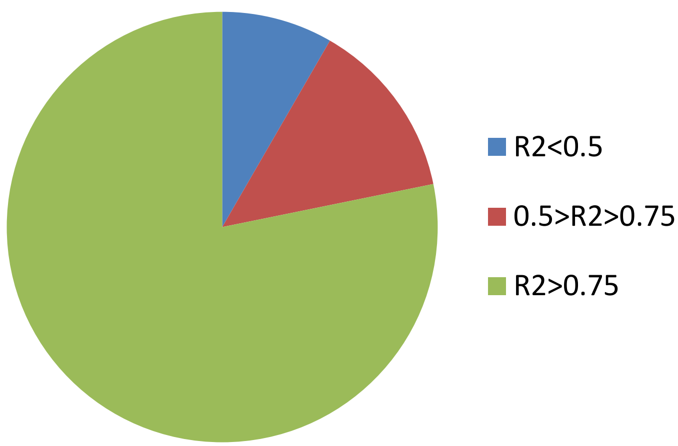
In previous projections, we used the EIA published forecast for Imported Crude Oil Price. However, EIA no longer publishes these prices, and instead publishes prices for Brent Spot (a European terminal) and West Texas Intermediate. Because we are interested in the prices electric utilities are likely to pay and a significant amount of crude oil is still imported into the U.S., we use the simple average of the forecasted prices for both of these terminals in our projection.

[15]Szymoniak, Nick; Fay, Ginny; Villalobos-Melendez, Alejandra; Charon, Justine; Smith, Mark. 2010. *Components of Alaska Fuel Costs: An Analysis of the Market Factors and Characteristics that Influence Rural Fuel Prices*. University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska State Legislature, Senate Finance Committee, 78 pages.
Fay, Ginny, Ben Saylor, Nick Szymoniak, Meghan Wilson and Steve Colt. 2009. *Study of the Components of Delivered Fuel Costs in Alaska: January 2009 Update.* Anchorage: University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska State Legislature, Senate Finance Committee, 22 pages.
Wilson, Meghan, Ginny Fay, Ben Saylor, Nick Szymoniak, and Steve Colt. 2008. *Components of Delivered Fuel Prices in Alaska*. Anchorage: University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska Energy Authority, 70 pages.

In addition, we use diesel prices utilities report under the Power Cost Equalization program. However, some utilities may fail to report every month or year resulting in missing values in the historic data. To provide a more robust projection, we statistically impute missing values, using the statistical software program STATA, based on the output of a linear regression of crude and diesel prices for each community.[16] Given the variation of the original number of observations and of the data quality for each community, some projections may appear to be 'better' than others. In statistical terminology, the coefficient of determination in our model, the Adjusted R-squared, indicates how well observed outcomes are replicated by the model; or in other words how well the independent variable explains the dependent variable. The Adjusted R-squared coefficient ranges from 0 to 1. The higher the coefficient value and the closer to 1, the better the goodness of fit of the model.

We ran regressions for 156 rural communities that experience the lag phenomena. Of these 156 communities, 122 community projections have an Adjusted R-squared value above 0.75, 21 community projections have an Adjusted R-squared value between 0.5 and 0.75 and only 13 communities have an Adjusted R-squared value below 0.5. Most communities with low Adjusted R-squared values are communities for which limited data are available or are located in the North Slope Borough, which has a fuel subsidy program in addition to the Power Cost Equalization program, which lowers variability in fuel prices over time and impacts the estimates' reliability.

**Figure 5. Distribution of Adjusted R2 Values for Rural Community Fuel Price Projections**




Source: ISER fuel price analysis.

In addition, we ran regressions for ten communities that do not experience the lag phenomena. All projections for these communities resulted in an R-squared value above 0.8.

### *Urban Fuel Prices*

Finally, regressions and projections were also performed for larger communities in Alaska that are not part of the Power Cost Equalization program: Anchorage, Fairbanks, Juneau, Kenai, Ketchikan, Palmer, and Wasilla. Unlike previous reports, the following communities are also included: Kodiak, Petersburg, Sitka and Wrangell. Projections of fuel prices for these communities are also based on the same underlying model described above and do not include a lag. However, public data regarding utility fuel

[16] This process is done using the statistical software STATA using the 'reg' and 'predict' commands.

prices are less available. These projections are based primarily on two sources of retail fuel price data: 1) data collected by the Alaska Housing and Finance Corporation (AHFC) and 2) the University of Alaska Fairbanks Cooperation Extension Service Food Survey (UAF CES). Retail prices can be significantly higher than the wholesale prices utilities pay. The Energy Information Administration also collects price data but these data are not available for all utilities. We conducted an analysis of the price difference for communities for which data are available from all three sources (Fairbanks and Juneau). Our analysis revealed that on average CES prices are about 24% higher than EIA published prices for the same community in the same time period. Also, as expected, AHFC prices are about 21% higher than EIA published prices. Hence, we adjusted fuel prices downward based on our analysis to reflect the likely wholesale prices utilities pay.

### *Home Heating Fuel Prices*

We were not able to rigorously determine a home delivery surcharge by statistical methods. However, there is some evidence of a relationship between residential home heating fuel prices, crude oil prices and PCE utility fuel prices (Table 2).

**Table 2. Correlations between residential home heating fuel, PCE utility fuel and crude oil prices**

| | Residential home heating fuel (rural) | PCE utility fuel | Crude oil |
|---|---|---|---|
| **Residential home heating fuel** | 1.0000 | | |
| **PCE utility fuel** | 0.7312 | 1.0000 | |
| **Crude Oil** | 0.4543 | 0.3938 | 1.0000 |

The average difference between PCE fuel and Alaska Housing Finance Corporation (AHFC) fuel survey prices (retail-heating) between years 2008 to 2011 was $1.58 (2011$). As a result, we suggest that the community utility fuel price plus $1.61 (2012$) 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), 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 3 below. These are the amounts applied in the Renewable Energy Fund project economic review model.

**Table 3. Suggested fuel premiums per gallon of displaced fuel**

| Gallons of Displaced Heating Fuel | Heating Fuel Premium (2012$) |
|---|---|
| <1,000 | $1.61 |
| 1,000 < 25,000 | $1.07 |
| 25,000 > 100,000 | $0.54 |
| >100,000 | $0.00 |

Source: ISER fuel price analysis.

Determining the value of an avoided gallon of fuel oil for space 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 since 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.

Other important factors besides crude oil prices affect the final community wholesale fuel price. These factors include: the varying time intervals between the placement of orders, the timing of departures of fuel deliveries from refineries, and fuel storage inventories in communities, as well as distances between refineries, fuel distributors and community storage facilities.[17] However, due to data limitations these factors are not represented in our simple statistical regression. Because no additional research was conducted to better inform home heating fuel price differentials, these estimates were adjusted to 2012 dollars only.

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[17] Szymoniak, Nick; Fay, Ginny; Villalobos-Melendez, Alejandra; Charon, Justine; Smith, Mark. 2010. *Components of Alaska Fuel Costs: An Analysis of the Market Factors and Characteristics that Influence Rural Fuel Prices*. University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska State Legislature, Senate Finance Committee, 78 pages.
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Wilson, Meghan, Ginny Fay, Ben Saylor, Nick Szymoniak, and Steve Colt. 2008. *Components of Delivered Fuel Prices in Alaska*. Anchorage: University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska Energy Authority, 70 pages.

## References


Alaska Energy Authority, Power Cost Equalization, fuel prices from fiscal years 1985 – 2011. The PCE Statistical Reports for fiscal years 2002 through 2010 can be obtained at: http://www.aidea.org/aea/programspce.html

Alaska Food Cost Survey, University of Alaska Fairbanks, Cooperative Extension Service. Surveys available at: http://www.uaf.edu/ces/fcs/

Alaska Housing Finance Corporation, Annual fuel price surveys conducted in years 1999 through 2011.

Black & Veatch, 2010, *Alaska Railbelt Regional Integrated Resource Plan (RIRP) Study*, Final Report, prepared for the Alaska Energy Authority, February 2010. . Available at: http://www.akenergyauthority.org/regionalintegratedresourceplan.html

Chugach Electric Association. Gas Supply Contract with ConocoPhillips, May 2009. Available at: http://rca.alaska.gov/RCAWeb/ViewFile.aspx?id=95B1BE87-1123-4D04-8766-964E7F813A77

Demer, Lisa. *Changes come to the Inlet's gas, oil outlook.* Anchorage Daily News. Published August 18, 2012. Available at: http://www.adn.com/2012/08/18/2593151/changes-come-to-inlets-gas-oil.html

Fay, G. and Saylor, B. 2010. *Alaska Fuel Price Projections 2010-2030*, Available at: http://www.iser.uaa.alaska.edu/Publications/oil_price_projection_aea07_2010_v1.xls

Fay, G. and Villalobos-Melendez, A. and Pathan, S. 2011. *Alaska Fuel Price Projections 2011-2035,* Technical Report, Institute of Social and Economic Research, University of Alaska Anchorage, prepared for the Alaska Energy Authority, 13 pages. Available at: http://www.iser.uaa.alaska.edu/Publications/Fuel_price_projection_2011-2035_final.pdf

Fay, G. and Villalobos-Melendez, A. and Pathan, S. 2012. *Alaska Fuel Price Projections 2012-2035,* Technical Report, Institute of Social and Economic Research, University of Alaska Anchorage, prepared for the Alaska Energy Authority, 14 pages. Available at: http://www.iser.uaa.alaska.edu/Publications/2012_07-Fuel_price_projection_2012-2035.pdf

Fay, Ginny, Ben Saylor, Nick Szymoniak, Meghan Wilson and Steve Colt. 2009. *Study of the Components of Delivered Fuel Costs in Alaska: January 2009 Update.* Anchorage: University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska State Legislature, Senate Finance Committee, 22 pages. Available at: http://www.iser.uaa.alaska.edu/Publications/fuelpricedeliveredupdate.pdf

Greenstone, M., Kopits, E., and Wolverton, A. 2011. *Estimating the social cost of carbon for use in U.S. federal rulemakings: a summary and interpretation*. NBER Working Paper 16913, available at: http://www.nber.org/papers/w16913.

Gas Strategies-Glossary: http://www.gasstrategies.com/

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 Spot and Future Prices (NYMEX). U.S. Energy Information Administration. Available at: http://www.eia.gov/dnav/ng/ng_pri_fut_s1_d.htm

Pickett, Robert M. Letter of Approval. Regulatory Commission of Alaska. May 17, 2010. File: TA316-8. LO#: L1000175. Available at: http://rca.alaska.gov/RCAWeb/Filings/EDocList.aspx?id=a541084b-3a55-4446-95e5-0c69ba8bced1

Smith, Brian. Morris News Service, Alaska. *Hilcorp closes Marathon sale, turns up Inlet gas*. Alaska Journal of Commerce. Available at: http://www.alaskajournal.com/Alaska-Journal-of-Commerce/February-Issue-3-2013/Hilcorp-closes-Marathon-sale-turns-up-Inlet-gas/

Statement of Commissioner Paul F. Lisankie concurring, joined by Chairman Robert M. Pickett. Regulatory Commission of Alaska. May 17, 2010. File TA316-8. LO#L1000175. Available at: http://rca.alaska.gov/RCAWeb/Filings/EDocList.aspx?id=a541084b-3a55-4446-95e5-0c69ba8bced1

Szymoniak, Nick; Fay, Ginny; Villalobos-Melendez, Alejandra; Charon, Justine; Smith, Mark. 2010. *Components of Alaska Fuel Costs: An Analysis of the Market Factors and Characteristics that Influence Rural Fuel Prices*. University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska State Legislature, Senate Finance Committee, 77 pages. Available at: http://www.iser.uaa.alaska.edu/Publications/componentsoffuel3.pdf

Tariff Advice Letter No. 373-8. From Chugach Electric Association, to Regulatory Commission of Alaska. May 30, 2013. Available at: http://www.chugachelectric.com/system/files/regulatory_affairs/ta373-8.pdf

U.S. Department of Energy, Energy Information Administration. Updated *Annual Energy Outlook 2012*. Available at: http://www.eia.doe.gov/oiaf/aeo/index.html

U.S. Department of Energy, Energy Information Administration. "U.S. Crude Oil Imported Acquisition Cost by Refiners (Dollars per Barrel)" (CORAC): http://tonto.eia.doe.gov/dnav/pet/pet_pri_rac2_dcu_nus_m.htm

Wilson, Meghan, Ginny Fay, Ben Saylor, Nick Szymoniak, and Steve Colt. 2008. *Components of Delivered Fuel Prices in Alaska*. Anchorage: University of Alaska Anchorage, Institute of Social and Economic Research. Prepared for the Alaska Energy Authority, 70 pages. Available at: http://www.iser.uaa.alaska.edu/Publications/Finalfuelpricedelivered.pdf

## Appendix A. Projection methodology

### *Fuel Oil Prices – Rural Communities*

The fuel oil price projection is based on crude oil price forecasts from EIA's *Annual Energy Outlook 2013* (AEO).

1. Access the EIA's Annual Energy Outlook 2013. Available at: http://www.eia.gov/oiaf/aeo/tablebrowser/

2. Obtain the forecast for Crude Oil Price, Brent and West Texas, from Table 1 for the Reference, Low Oil Price, and High Oil Price cases.

3. Obtain the historical 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, adjust crude prices to 2012 dollars ("real crude price") using the appropriate average CPI-U (U.S. Consumer Price Index for All Urban Consumers). Available at: http://www.bls.gov/CPI/.

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 1985 – 2012. The PCE Statistical Reports for fiscal years 2002 through 2012 can be obtained from the following URL: http://www.aidea.org/aea/programspce.html.[18]

7. Calculate the average CPI-U by fiscal year, and adjust PCE prices to real dollars based on the average CPI-U.

8. Perform an ordinary least squares regression for each community where the real fuel price per gallon is the dependent variable and real crude price per gallon lagged by one year is the independent variable. Then repeat the regression without lagging the crude oil price. Evaluate the regression output (R-square and P-value) to select the parameters that better explain the crude-fuel relationship for each community. The constant term of the regression represents the intercept of each community and the beta of the crude oil price represents the slope.

9. 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

[18] Data from prior years were obtained from printed copies of statistical reports, but are not available through the AEA website. The forecast workbook includes a worksheet with a list of communities and their respective prices from year 1985 to 2011.

- Thorne Bay/Kasaan: Craig
- Kasigluk: Nunapitchuk
- Pitkas Point: St. Mary's
- 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.

10. Apply the slope and intercepts from the regression to the EIA *Annual Energy Outlook* forecasts (Low, Reference, and High cases) to predict fuel oil price per gallon for each PCE community as a function of average Crude Oil Price per gallon of the Brent and West Texas forecasts (lagged by one year or not, as appropriate) for each year from 2012 to 2035.

11. Continuing with changes implemented in the June 2011 projection, the '$CO_2$ Equivalent Allowance Cost' is no longer added to allow flexibility in the use of these projections. We now appropriately add the '$CO_2$ Equivalent Allowance Cost' in the benefit-cost model rather than directly into the fuel price projection.

12. Take the moving average three ($MA_3$) to smooth out the projections for all three cases.

### *Fuel Oil Prices – Urban Communities*

1. For urban communities: Anchorage, Fairbanks, Juneau, Kenai, Ketchikan, Palmer, Wasilla, Sitka, Wrangell, Kodiak and Petersburg; obtain prices for heating oil from Alaska Housing Finance Corporation's annual fuel price surveys conducted in years 2000 through 2012 (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/). The Alaska Food Cost Survey includes data from 1996 to 2012. However, even after combining data from both datasets there will be missing data points. Adjust prices to real dollars.

2. Collect fuel price data for urban communities from the U.S. Energy Information Administration Survey Form 923 data file, Schedule 5. Calculate the wholesale-retail price difference (percentage) for each community (when data are available) between EIA and AHFC and CES prices. Adjust downward the prices to be used on the regression by the appropriate percent difference depending on data source.

3. Integrate CORAC real fuel prices for the appropriate period into the dataset.
   For each community, perform a linear regression with the diesel price as the dependent variable and CORAC as the independent variable.

4. Use the regression coefficients to project heating diesel prices as a function of the simple average of Brent Spot and West Texas Intermediate forecast prices per gallon (Low, Medium, and High cases) for each year from 2013 to 2035 for each community.

### *Home Heating Fuel Adder*

The calculated prices are for utilities. Calculate the correlation between AHFC and PCE prices. Since no clear relationship was found between AHFC surveyed home heating oil prices and PCE utility fuel prices, estimate the average difference ($1.61, 2012$).

### *Natural Gas Projection*

1. Obtain the U.S. Energy Information Administration forecast of Henry Hub Spot prices. Set forecast as reference case.
2. Adjust forecast to 2012 dollars.
3. Estimate the average percentage difference between the EIA Henry Hub forecasted prices and the floor price per unit of the marginal gas supply. Adjust EIA's reference case by that rate.
4. Adjust the modified Henry Hub projected prices to 90% of the reference case to establish the Low projection.
5. Adjust the modified Henry Hub projected prices to 125% of the reference case to establish the High projection.