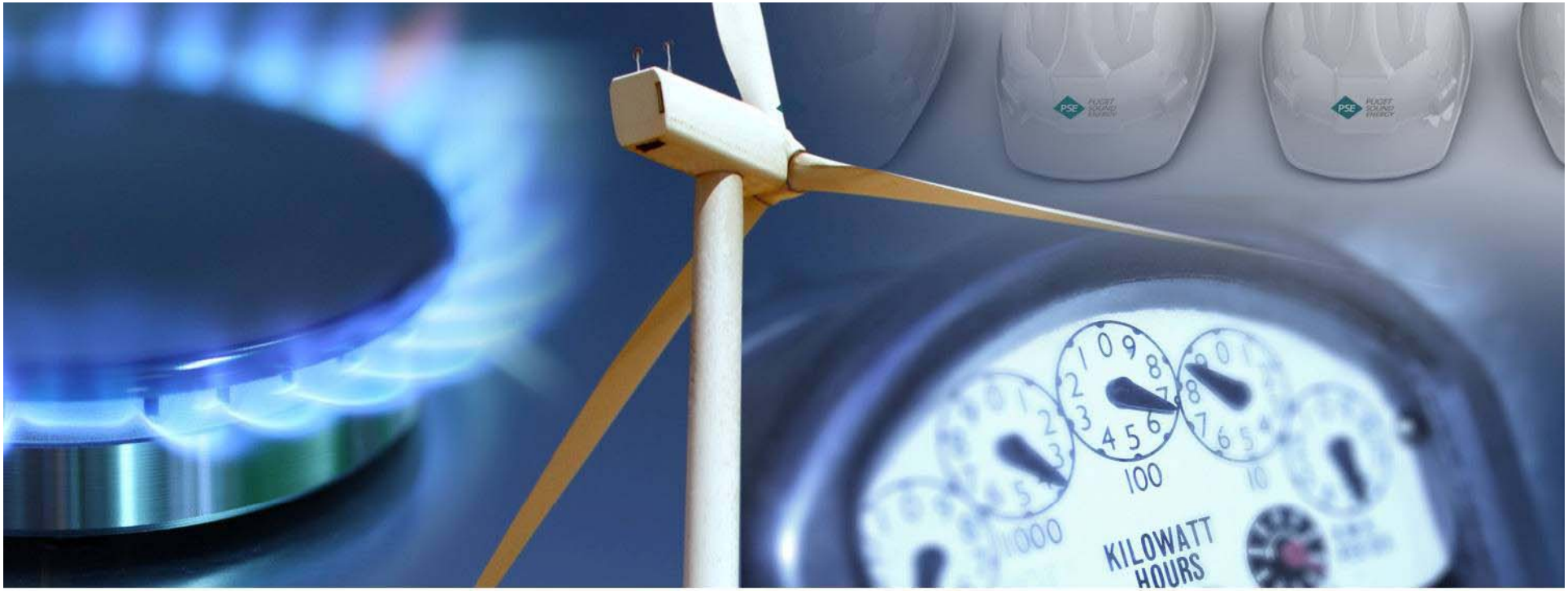

Avoided Cost Calculations for Natural Gas Energy Efficiency Programs

Presented to WUTC Staff, November 9, 2012

Puget Sound Energy

Bobbi Wilhelm

Goals of Discussion

1. Provide an overview of PSE's avoided cost of natural gas, used in benefit-cost analyses of gas conservation programs

2. Understand the inputs into PSE's avoided cost of natural gas

3. Includes a technical appendix that fully describes our process of calculating avoided cost of natural gas.

Overview

Overview of Avoided Cost of Natural Gas

- Avoided costs are primarily composed of the following elements
  - Weighted Average Cost of Gas, by end-use
  - Avoided Pipeline Demand Charge
  - Avoided Pipeline Variable Transportation Charge
  - Pipeline Fuel Reimbursement
  - Avoided Distribution Capacity Upgrades

- PSE uses inputs from its most recent completed IRP, unless there has been a significant change in values

Weighted Average Cost of Gas

- Not all savings are created equally
  - Some items save energy when gas relatively costly
  - Some items save energy when gas is relatively inexpensive

- A weighted average commodity cost
  - Accounts for varying time of savings
  - Calcalculated for six representative end-uses
  - Utilizes monthly Sumas gas forecasts & monthly end-use load shapes for the calculation of weighted average commodity cost

- Weighted average commodity cost is and input into the avoided cost calculations

Avoided Pipeline Demand Charge

- Account for potential avoided contract costs with the Northwest Pipeline
- Capacity is paid on a per day charge, year-round, even on days when PSE does not need the full amount of reserved capacity on the pipeline
- To the extent that gas efficiency programs mitigate peak demand, the efficiency programs assist PSE in avoiding some of the pipeline capacity costs
- This avoided cost is dependant upon savings which occur on peak day

Avoided Pipeline Variable Transportation Charge

- Represents the operation and maintenance costs on the pipeline
- That charge is a flat charge per dekatherm
- Pipeline variable transportation charge does not vary by end-use
- When PSE saves a dekatherm of gas at a customer location, PSE avoids paying the pipeline variable transportation charge on that dekatherm of gas

Pipeline Fuel Reimbursement

- Account for the additional savings on the fuel used by the compressors which move natural gas though the pipelines

- As natural gas moves though the pipeline system, a small portion of the natural gas is consumed as fuel for the compressor systems that move the natural gas from various points in the pipeline

- The pipeline reimbursement rates vary every 6 months, but generally range from 2%-3%. PSE applied a 2.9 % rate for fuel reimbursement when calculating the 2012-2013 avoided costs

Deferred Distribution Capacity Costs

- Account for the deferred cost of pipeline reinforcements

- When peak demand increases, pipelines need to be reinforced to support the additional flow of natural gas

- In as much as energy efficiency projects reduce peak demand, PSE can defer pipeline reinforcement projects

Technical Appendix

Appendix Overview

- Appendix provides specific details about:
  - Weighted Average Cost of Gas, by end-use (Section A1)
    - Overview and calculation
  - Avoided Pipeline Demand Charge (Section A2)
    - Overview , methodology, and calculation
  - Avoided Pipeline Variable Transportation Charge (Section A3)
    - Overview and calculation
  - Pipeline Fuel Reimbursement (Section A4)
    - Overview and calculation
  - Avoided Distribution Capacity Upgrades (Section A5)
    - Overview and calculation
- Calculating the Avoided Cost of Natural Gas, Present Value (Section A6)
  - Calculation

Section A1

Weighted Average Cost of Natural Gas

Weighted Average Cost of Natural Gas

- A weighted average market price of natural gas is used because it accounts for the timing of savings by end use
- A weighted price provides a more accurate reflection of avoided commodity costs than a simple average
- PSE calculated the weighted average annual market price of natural gas over the next 20 years (IRP period) for each of the six representative end-uses
  - PSE then used an inflation rate of 2.5% to estimate a weighted average annual market price of natural gas for the remaining 10 years
- PSE uses the estimated average monthly natural gas prices (Sumas) and applies monthly gas load shapes from its most recent IRP
  - PSE has updated its gas prices in 2013 to be consistent with the forecast used in the upcoming 2013 IRP due to significant changes

Weighted Market Price of Natural Gas

Calculation

For 20 years:

$$WAAMPG_{j_y} = \sum_{m=1}^{12} (load_{j_m}) * (price_{m_y})$$

Where:

- $load_{jm}$: Percent of one therm used in month m for end-use *j*
- $Price_{my}$: Price of natural gas in month m of year *y*
- $WAAMPG_{jy}$: Weighted average annual price of gas for end-use *j* in year *y*

Section A2

Avoided Pipeline Demand Charge

Avoided Pipeline Demand Charge- Overview

- Pipeline Demand Charge is added to avoided costs to account for potential avoided contract costs with the Northwest Pipeline.
- These contract costs are paid to reserve pipeline capacity for peak demand
- When there is large demand for natural gas, PSE first utilizes the natural gas in PSE owned storage facilities and other available PSE peaking resources
- To the extent that PSE's demand at peak outweighs PSE's ability to meet that demand with current peaking resources, PSE must buy gas from other sources
- Capacity is paid on a per day charge, year-round, even on days when PSE does not need the full amount of reserved capacity on the pipeline

Avoided Pipeline Demand Charge, cont.

- The 2011 IRP indicates that PSE has enough capacity on the Northwest Pipeline to meet future demands though 2015

- In 2016, PSE will need to begin purchasing additional capacity on the pipeline at $0.45 per dekatherm of capacity per day, or $164.25 per year, per dekatherm of capacity

- In 2017, the cost per dekatherm on the pipeline will increase by five percent, costing PSE $0.4725 per dekatherm of capacity per day, or $172.4625 per year, per dekatherm of capacity. That cost will remain flat for the five year contract and will increase by five percent every five years

- To calculate the avoided cost of pipeline demand charges, PSE must multiply the yearly pipeline demand charge by the measure savings which occur on peak.

Methodology for Estimated Peak Savings by end-use

The first thing PSE must to do estimate the avoided pipeline demand charge is to estimate savings which occur on peak

- Peak is defined as our expected maximum daily load
- PSE must estimate peak savings for each end-use, *j*, by multiplying the inverse of the load factor of end use *j* by the average load of end-use *j*
- PSE calculated peak savings with two different methodologies
  - For weather-sensitive end-uses, PSE used the gas forecast to estimate the load factor
  - For non-weather-sensitive end-uses, PSE utilized individual end-use load shapes to estimate the load factor

Methodology for Estimating Peak Savings, Cont.

- Each End-Use has a load shape which provides information on how that end-use uses energy throughout the year. This can be used to estimate average daily usage and end-use peak usage, and it can be used to estimate load factor
  - For weather sensitive loads, PSE avoided cost team believed that a better estimate of load factor would be derived if the forecast in *Sendout* was used, rather than the end-use, because the load forecast better correlates with our actual peak
  - Therefore individual load shapes for non-weather-sensitive end-uses were used to estimate the load factor for those end-uses
- The methodology used to calculate peak savings for weather sensitive and non-sensitive end-uses is described in the following slides.

Peak savings for weather sensitive end-uses

- To calculate the percentage of savings which occur coincident with system peak, the analyst first estimated a load factor, which is simply the average daily load divided by the load on peak day.
- These load factors were calculated for residential and non-residential customer class. The load factor is defined below:

$$LF_c = ADLW_c / PDLW_c$$

Where:

- LF_c: Load factor for customer class *c*, either residential or non-residential
- $ADLW_c$: Average daily load for weather sensitive end-uses for customer class *c*
- $PDLW_c$: Peak day load for weather sensitive end-uses for customer class *c*

Load factors were calculated using the most recent (2011) IRP forecasts for the gas sendout.

Peak savings for weather sensitive end-uses

- Next, the inverse of that load factor, which provides a percent of the average daily load which occurs on peak day, is multiplied by the average daily load to obtain peak demand savings

Peak savings are defined below:

$$PDSW_c = [(PDLW_c)/(ADLW_c)] * (1/365)$$

Where:

- PDSW*c*: Peak savings, percent of weather sensitive load which occurs on peak day for class c (residential or non-residential)
- PDLW*c*:Peak day load for weather sensitive end-uses in customer class *c*
- ADLW*c*: Average daily load for weather sensitive end-uses in customer class *c*

Avoided Pipeline Demand Charge For Weather Sensitive End-Uses

The peak demand savings is then multiplied by the yearly demand charge to obtain the avoided cost of pipeline demand charges for end-use j in year y

The peak demand charge is defined below:

$$PDC_{j_y} = (PDSW_{j_c}) * (PDC_y)$$

Where:

- PDC_{jy} : Avoided pipeline demand charge for end-use *j* in year *y*.
- $PDSW_{jc}$: Peak demand savings for weather-sensitive end-use *j* in customer class *c*
- PDC_y: Avoided pipeline demand charge for year *y*

Calculation of peak savings for non-weather sensitive loads

- Peak savings were calculated by estimating a percent of one dekatherm of savings which occurs on peak, using individual end-use load shapes

- The load factor is calculated as the average daily load for the non-weather sensitive end-use, *j*, divided by the peak load of end-use *j*

The load factor is defined below:

$$LF_j = ADLNW_j / PDLNW_j$$

Where:

- LF_j: Load Factor for end-use *j*
- $ADLNW_j$: Average daily load for non-weather sensitive end-use *j*
- $PDLNW_j$: Peak day load for non-weather sensitive end-use *j*

Calculation of peak savings for non-weather sensitive loads

- The inverse of the load factor is then calculated to provide a percent of the average daily load which occurs on peak day, for end-use j
  - This percentage is multiplied by the average daily load for end-use j (one dekatherm spread over a year) to obtain peak demand savings

Peak savings are defined below:

$$PDSNW_j = [(PDLNW_j)/(ADLNW_j)]*(1/365)$$

Where:

- $PDSNW_j$: Peak savings for non-weather sensitive, percent of load for end-use *j*, which occurs on the peak day for end-use *j*
- $PDLNW_j$: Peak day load for non-weather sensitive end-use *j*
- $ADLNW_j$: Average daily load for non-weather sensitive end-use *j*

Avoided Pipeline Demand Charge For Non-Weather Sensitive End-Uses

The peak demand savings is then multiplied by the yearly demand charge to obtain the avoided cost of pipeline demand charges for end-use *j* in year *y*

The peak demand charge is defined below:

$$PDC_{j_y} = (PDSNW_j) * (PDC_y)$$

Where:

- PDC_{jy} : Avoided pipeline demand charge for end-use j in year y
- $PDSNW_j$: Peak savings for non-weather sensitive end-use j
- PDC_y: Pipeline demand charge for year y

Section A3

Avoided Pipeline Variable Transportation Charge

Avoided Pipeline Variable Transportation Charge

- The avoided pipeline variable transportation charge represents the operation and maintenance costs on the pipeline

- The costs are independent of the time of flow

- The costs are a flat charge per dekatherm, at $0.0319 per dekatherm

- When PSE saves a dekatherm of gas at a customer location, PSE avoids paying the pipeline variable transportation charge on that dekatherm of gas.
  - The avoided pipeline variable transportation charge does not vary by end-use
  - The price is held constant over the course of the 30 year timeframe for avoided cost calculations

Section A4

Avoided Pipeline Fuel Reimbursement

Pipeline Fuel Reimbursement

- Account for the additional savings on the fuel used by the compressors which move natural gas though the pipelines

- As natural gas moves though the pipeline system, a small portion of the natural gas is consumed as fuel for the compressor systems that move the natural gas from various points in the pipeline

- The pipeline reimbursement rates vary every 6 months, but generally range in the 2-3%. PSE applied a 2.9 % rate for fuel reimbursement when calculating the 2012-2013 avoided costs

- Every time a PSE program saves a dekatherm of natural gas at a PSE customer location, PSE avoids both purchasing that unit of natural gas and purchasing additional gas to fuel the compressors

Pipeline Fuel Reimbursement- Calculation

$$PFRC_{j_y} = WAAMPG_{j_y} * \text{Re}\,imbursemen\,tRate$$

Where:

- $PFRC_{jy}$: Avoided Pipeline Fuel Reimbursement charge for end-use *j* in year *y*

Section A5

Deferred Distribution Capacity Cost

Deferred Distribution Capacity Cost

- Account for the deferred cost of pipeline reinforcements
- When peak demand increases, pipelines need to be reinforced to support the additional flow of natural gas
- In as much as energy efficiency projects reduce peak demand, PSE can defer pipeline reinforcement projects

- PSE estimated cost of pipeline reinforcements, obtained from our Gas System Planning group, was used to estimate the cost of pipeline reinforcements in years 2012 through 2041
  - Upon receiving a cost estimate for distribution capacity projects in 2010 dollars, the PSE analyst estimated project costs though 2041 by inflating the cost in the year previous by 2.5%

Deferred Distribution Capacity Cost

- Reinforcement costs on a pipeline are a onetime cost
  - Those costs are simply deferred, not necessarily avoided by EES programs
  - The yearly avoided costs of pipeline distribution capacity costs are represented as an avoided payment, or the yearly value of a levelized cost.
  - The levelized payments were calculated over a 35 year timeframe as advised by the gas planning group
  - Each year 2012 though 2041 has a unique deferred payment, which is based on the payment for that year's estimated distribution capacity costs.

Section A6

Creating the Calculation of Avoided Cost of Natural Gas

Nominal Avoided Cost of Natural Gas

$$TCG_{j_y} = WAAMPG_{j_y} + PDC_{j_y} + PVTC + PFRC_{j_y} + DCC_{j_y}$$

Where:

- TCG_{jy}: Total nominal avoided cost of natural gas for end-use *j* in year *y*
- $WAAMPG_{jy}$: Weighted average annual market price of natural gas for end-use *j* in year *y*
- PDC_{jy}: Avoided pipeline demand charge for end-use *j* in year *y*
- PVTC: Pipeline variable transportation charge
- $PFRC_{jy}$: Pipeline fuel reimbursement charge for end-use *j* in year *y*
-
- DCC_{jy}: Avoided cost of distribution capacity

Calculation of Avoided Cost of Natural Gas

- For inclusion in the benefit cost calculations, the avoided cost of natural gas is calculated as the present value of the stream of avoided cost over the life of the measure being assessed

- To calculate the present value of the stream of avoided costs, PSE first calculates the nominal avoided cost of energy for each year

  - Upon completion of the nominal cost calculations, PSE obtains a present value of avoided cost for each year

    - After calculating the present value per year, PSE calculates the stream of avoided costs by summing the present value of avoided costs for each year, y, and every year previous

Present Value of Avoided Cost of Natural Gas, for year Y

- PSE's weighted average annual cost of capital (WACC) is used as the discount rate. This rate is adopted from the commission-approved cost of capital structure from the General Rate Case which was utilized in the most recent IRP. Present value is calculated in time zero; not time one

- The present value of the total avoided cost of natural is defined below:

$$PVG_{j_y} = TCG_{j_y} \Big/ (1+I)^y$$

Where:

- PVG_{jy} : Present value of year *y*'s avoided costs of energy for end-use *j*
- TCG_{jy}: Total avoided cost of energy for end-use *j* in year *y*
- I: Interest rate used for discounting, PSE weighted average annual cost of capital

Present Value of the Stream of Avoided Costs of Natural Gas

- The present values of the stream of avoided costs are calculated for multiple years so that PSE can assess measures with various measure lives
  - These are equal to the sum of avoided costs for each year, y, and all years previous.

$$PVSACG_j = \sum_{y=1}^{N} TCG_{j_y} \Big/ (1+I)^y$$

Where:

- PVTACGj: Present value of the avoided
- TCGjy: Total avoided cost of natural gas for end-use j in year y.
- I: Interest rate used for discounting money, PSE weighted average annual cost of capital
- N: Measure life