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Online Appendix to paper by Catherine Hausman and Ryan Kellogg

A1.1 Manufacturing Data

Here we give details on the manufacturing data used in section 5. The first data source is the Economic Census, for years 2002, 2007, and 2012. It includes sector-level establishment counts, total employment, total compensation, and total capital expenditure. While the ECs also provide information on the dollar value of each sector's output and its value added, we do not use this information because it introduces considerable noise from fluctuations in industrial commodity prices.

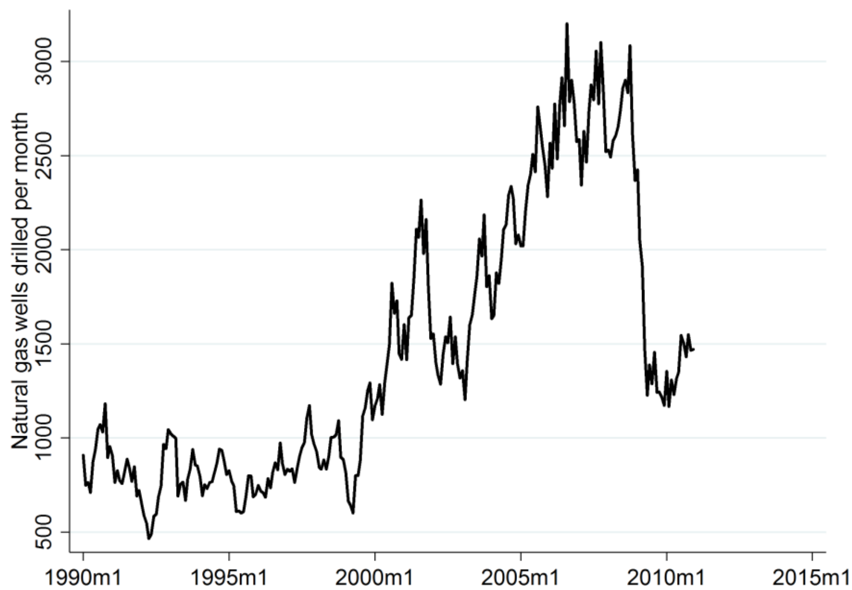
The second data source is the Bureau of Economic Analysis 2007 input-output tables, which we use for direct and indirect natural gas requirements at the sectoral level. (An alternative data source would be the EIA's 2010 Manufacturing Energy Consumption Survey (MECS); however, the MECS data are much more aggregated, with many sectors reported at the 3-digit NAICS level.) In the BEA system, direct natural gas inputs into manufacturing flow almost entirely through sector 221200, natural gas distribution. Manufacturing sectors also receive small input flows from sector 211000, oil and gas extraction. It is not clear whether these flows reflect natural gas input (which we would like to capture in our intensity measures) or oil / petroleum input (which we do not want to capture). To be conservative, we do not reclassify these small flows into NAICS 221200.

The total requirements table is calculated as $(I - MD)^{-1}$, where M is the Make table (production by each row industry of each column commodity), D is the direct requirements table (dollars of each commodity row input per dollar of column industry output), and I is the identity matrix. The manufacturing sector natural gas requirements come from the row of the total requirements table corresponding to NAICS 221200. The raw D matrix from the BEA has electricity generation obtaining its gas requirement almost entirely from NAICS 211000 (oil and gas extraction) rather than NAICS 221200. We therefore transfer this requirement to NAICS 221200 before calculating the total requirements table (this transfer is valid because only a trivial fraction of electricity generation uses petroleum products as fuel).

After merging the data from the Economic Censuses and from the BEA tables, we have 230 manufacturing sectors. The only sector that does not cleanly merge across the EC and BEA data is NAICS 339100 (medical equipment). Subsector 339111 appears in the 2002 EC but not in the other datasets, and the other datasets also lack an "other medical equip- ment" category in which 339111 might be included. We therefore drop NAICS 339100 from our analysis. We also drop sectors 316000 (leather and allied products), 331410 (smelt- ing of non-ferrous and non-aluminum metals), and 335224 (household laundry equipment manufacturing) because their data were omitted from some EC years due to confidentiality issues.

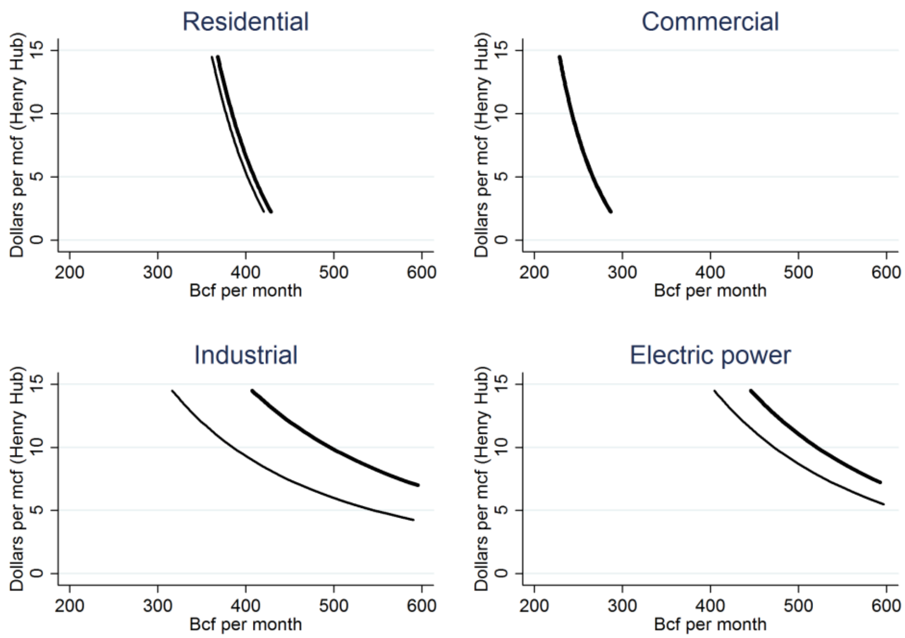
A1.2 Supplementary Figures and Tables

Figure A1: U.S. Natural Gas Drilling



Note: Wells include both development and exploratory wells. Wells producing both oil and natural gas are excluded. Source: EIA.

Figure A2: Estimated Demand Shift, 2007 to 2013, by Sector



Note: The thin lines show 2007, and thick lines 2013. We assume that supply and demand are constant elasticity (at the sectoral level) over the range of the data, with elasticities given by the estimates in table 1. We back out the scale parameters for the demand and supply curves for each year using observed prices and quantities and assuming a constant retail price markup.

Table A1: Potential Demand Shifters

	2007	2013	% change
Panel A: Impacts to All End-Uses			
Real GDP, trillions	15.9	16.8	5.6%
Population, millions (all regions)	301	316	5.1%
Real median income (all regions)	56,000	52,000	-8.0%
Panel B: Impacts to Residential (Heating) Only			
Heating degree days, daily (population weighted)	11.5	12.1	5.1%
Population, millions (cold states)	120	124	3.0%
Real median income (cold states)	59,000	56,000	-4.2%
Panel C: Impacts to Industrial Only			
Employment, non-gas intensive industries, millions	5.8	4.9	-16%
Establishments, non-gas intensive industries, thousands	146	128	-12%
Panel D: Impacts to Electricity Only			
Cooling degree days, daily (population weighted)	3.8	3.6	-4.9%
Population, millions (hot states)	178	190	6.4%
Real median income (hot states)	53,000	49,000	-9.2%
Electricity generation, billion MWhs: total	4.2	4.1	-2.4%
Fossil fuels	3.0	2.7	-8.4%

Note: This table reports changes to potential demand shifters for natural gas. GDP is in trillions of 2013 dollars. Median income (household) is in 2013 dollars. Hot states are the 24 warmest, as measured by average HDDs for 1981-2013; cold states are the 24 coldest (as described in the text, Alaska and Hawaii are dropped). Non-gas-intensive industries are those with gas intensity below the (weighted) median, according to the 2007 BEA input-output tables. We present only the trends for non-gas-intensive industries, so as not to confound with the impact of the natural gas price fall.

Table A2: First Stage: Demand

	Residential	Commercial	Industrial	Electric power
Cumulative other HDDs, hundreds	0.47	0.56	0.75	0.89
	(0.14)	(0.17)	(0.23)	(0.26)
Own HDDs, hundreds	-0.78	-0.47	-0.22	-0.51
	(0.44)	(0.48)	(0.59)	(0.66)
Own CDDs, hundreds	-0.52	-1.16	-1.76	-1.44
	(0.56)	(0.74)	(1.13)	(1.18)
Lagged demand	-0.23	-0.25	-0.07	0.01
	(0.05)	(0.07)	(0.04)	(0.02)
Observations	6912	6912	6912	6849

Note: This table reports first stage estimates for the 2SLS estimates presented in table 1. The dependent variable is retail price in each sector in logs. The excluded instrument in the second stage is cumulative other heating degree days (HDDs). As described in the text, the instrument is constructed with lags 2 through 12. The time period covered is 2002-2013. All specifications include month-of-year by state fixed effects, a linear time trend, and lagged cooling and heating degree days. Standard errors are two-way clustered by sample month and state.

Table A3: First Stage: Supply

	Henry Hub price
Lagged HDDs, hundreds	4.46
	(2.33)
Lagged CDDs, hundreds	6.79
	(3.82)
Current HDDs, hundreds	3.52
	(1.96)
Current CDDs, hundreds	2.69
	(2.78)
Lagged supply	0.94
	(0.14)
Observations	108

Note: This table reports first stage estimates for the 2SLS estimates presented in table 1. The dependent variable is the Henry Hub price in logs. The excluded instruments in the second stage are one-month lagged heating and cooling degree days. The time period covered is 2002-2010. Month-of-year effects and a linear time trend are included. Standard errors are Newey-West with 17 lags.

Table A4: Alternative Instruments: Demand

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A: Residential			
log(Price)	-0.14	-0.10	-0.15	-0.14	-0.12	-0.37	-0.13
	(0.12)	(0.12)	(0.12)	(0.14)	(0.11)	(0.17)	(0.11)
y_{t-1}	0.42	0.43	0.42	0.42	0.43	0.38	0.43
	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.04)
Long-run price	-0.25	-0.18	-0.25	-0.25	-0.22	-0.59	-0.22
	(0.20)	(0.21)	(0.19)	(0.23)	(0.18)	(0.24)	(0.18)
First-stage F	8.86	8.84	0.97	7.32	6.93	7.00	11.20
				Panel B: Commercial			
log(Price)	-0.13	-0.08	-0.11	-0.11	-0.10	-0.27	-0.13
	(0.08)	(0.08)	(0.08)	(0.11)	(0.07)	(0.12)	(0.07)
y_{t-1}	0.58	0.59	0.58	0.58	0.59	0.54	0.58
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)
Long-run price	-0.30	-0.20	-0.26	-0.26	-0.23	-0.60	-0.31
	(0.18)	(0.19)	(0.17)	(0.25)	(0.17)	(0.22)	(0.16)
First-stage F	9.81	9.08	0.96	4.45	6.17	7.13	11.19
				Panel C: Industrial			
log(Price)	-0.15	-0.15	-0.17	-0.16	-0.16	-0.20	-0.19
	(0.07)	(0.07)	(0.07)	(0.13)	(0.07)	(0.19)	(0.09)
y_{t-1}	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.10)	(0.09)
Long-run price	-0.55	-0.54	-0.61	-0.58	-0.57	-0.71	-0.66
	(0.16)	(0.18)	(0.19)	(0.39)	(0.17)	(0.47)	(0.21)
First-stage F	10.12	8.37	0.97	2.89	5.65	4.24	10.62
				Panel D: Electric Power			
log(Price)	-0.15	-0.26	-0.23	-0.02	-0.14	-0.40	-0.26
	(0.14)	(0.18)	(0.16)	(0.32)	(0.14)	(0.33)	(0.18)
y_{t-1}	0.68	0.68	0.68	0.68	0.68	0.68	0.68
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Long-run price	-0.46	-0.80	-0.71	-0.07	-0.45	-1.24	-0.79
	(0.41)	(0.55)	(0.47)	(0.99)	(0.43)	(0.98)	(0.54)
First-stage F	11.6	8.79	1.16	3.06	6.44	5.10	13.34
Instruments:							
Shorter cumulative HDDs	Y						
Longer cumulative HDDs		Y					
All lags of HDDs			Y				
Cumulative CDDs				Y	Y		
Cumulative HDDs					Y		
Local HDDs						Y	
East/West HDDs							Y

Note: This table reports 2SLS price elasticity estimates for U.S. natural gas demand. The dependent variable is quantity consumed, in logs. The cumulative heating and cooling degree days (HDDs and CDDs) IVs use data from other regions and lags 2 through 12. The "shorter" IV uses lags 2 through 11, and the "longer" IV uses lags 2 through 13. The "all lags" IV uses multiple IVs (lags 2 through 12) rather than a single cumulative IV. The "local" IV uses only weather in the own state. The "East/West" IV uses weather only in the own half of the country (with census region "West" versus all other census regions) and excludes own-division weather. The time period covered is 2002-2013, so there are 6912 observations in each specification; missing values for the electricity specifications lead to 6849 observations. Standard errors are two-way clustered by sample month and state.

Table A5: Alternative Controls: Demand

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A: Residential						
log(Price)	-0.11	-0.07	-0.20	-0.08	-0.11	0.05	-0.10
	(0.11)	(0.11)	(0.29)	(0.29)	(0.12)	(0.13)	(0.12)
Long-run price	-0.19	-0.13	-0.41	-0.14	-0.17	0.09	-0.20
	(0.19)	(0.20)	(0.56)	(0.50)	(0.18)	(0.25)	(0.23)
First-stage F	9.99	12.62	6.91	6.20	10.12	7.66	9.64
	Panel B: Commercial						
log(Price)	-0.12	-0.11	-0.07	<0.01	-0.10	0.02	-0.07
	(0.08)	(0.07)	(0.22)	(0.19)	(0.08)	(0.08)	(0.08)
Long-run price	-0.25	-0.28	-0.20	<0.01	-0.22	0.04	-0.20
	(0.15)	(0.16)	(0.58)	(0.47)	(0.16)	(0.21)	(0.24)
First-stage F	10.99	15.87	14.87	14.56	10.7	8.36	9.78
	Panel C: Industrial						
log(Price)	-0.17	-0.16	-0.05	-0.01	-0.18	-0.14	-0.10
	(0.07)	(0.07)	(0.05)	(0.04)	(0.08)	(0.04)	(0.04)
Long-run price	-0.59	-0.56	-0.19	-0.05	-0.55	-0.50	-0.62
	(0.17)	(0.16)	(0.18)	(0.14)	(0.17)	(0.21)	(0.19)
First-stage F	10.81	14.29	27.10	27.21	10.05	11.56	9.38
	Panel D: Electric Power						
log(Price)	-0.15	-0.24	0.20	0.35	-0.17	-0.04	-0.05
	(0.17)	(0.15)	(0.57)	(0.57)	(0.15)	(0.14)	(0.13)
Long-run price	-0.44	-0.84	0.60	1.07	-0.50	-0.12	-0.19
	(0.49)	(0.48)	(1.75)	(1.81)	(0.42)	(0.44)	(0.48)
First-stage F	12.19	15.66	5.52	6.31	12.04	12.66	11.18
Controls:							
Lagged HDDs and CDDs		Y	Y	Y	Y	Y	Y
State by month effects	Y	Y		Y	Y	Y	Y
Census division by month effects			Y				
Linear time trend	Y				Y	Y	
Year effects			Y	Y			
Time trend by census division					Y		
Cumulative local HDDs						Y	
y_{t-2}							Y

Note: This table reports 2SLS price elasticity estimates for U.S. natural gas demand. The dependent variable is quantity consumed, in logs. The specifications are identical to those in table 1 except for the controls. There are 6,912 observations in the residential, commercial, and industrial equations, and 6,849 observations in the electric power equations. Standard errors are two-way clustered by sample month and state.

Table A6: Alternative Instruments: Supply

	(1)	(2)	(3)	(4)	(5)
log(Price)	0.07	0.10	0.06	0.13	0.11
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
y_{t-1}	0.91	0.88	0.91	0.85	0.87
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
Long-run price	0.75	0.84	0.72	0.88	0.85
	(0.16)	(0.14)	(0.22)	(0.14)	(0.14)
First-stage F	2.33	4.50	3.22	13.32	9.53
Instruments:					
One-month lagged HDDs	Y	Y	Y	Y	Y
One-month lagged CDDs	Y	Y	Y	Y	Y
Cumulative HDDs	Y				
Cumulative CDDs	Y				
Lagged Henry Hub price		Y			Y
Lagged demand			Y		Y
Lagged oil wells				Y	Y

Note: This table reports 2SLS price elasticity estimates for U.S. natural gas supply. The dependent variable is quantity supplied, in logs. The lag length for Henry Hub price, quantity demanded, and oil wells drilled is six months. Total quantity demanded is the sum of residential, commercial, industrial, and electric power natural gas demand in all states. The time period covered is 2002-2010, so there are 108 observations in each specification. Month-of-year effects and a linear time trend and current population-weighted HDDs and CDDs are included. Standard errors are Newey-West with 17 lags.

Table A7: Alternative Controls: Supply

	(1)	(2)	(3)	(4)	(5)
log(Price)	0.10	0.09	0.05	0.05	0.09
	(0.05)	(0.05)	(0.07)	(0.06)	(0.05)
y_{t-1}	0.89	0.89	0.77	0.93	0.78
	(0.04)	(0.04)	(0.06)	(0.05)	(0.16)
y_{t-2}					0.11
					(0.14)
Long-run price	0.88	0.81	0.23	0.66	0.83
	(0.18)	(0.16)	(0.30)	(0.42)	(0.17)
First-stage F	4.09	4.37	6.50	3.76	4.54
Controls:					
HDDs and CDDs		Y	Y	Y	Y
Month-of-year effects	Y	Y	Y	Y	Y
Linear trend	Y			Y	Y
Year effects			Y		
Monthly linear trends				Y	

Note: This table reports 2SLS price elasticity estimates for U.S. natural gas supply. The dependent variable is quantity supplied, in logs. The specifications are identical to those in table 1 except for the controls. There are 108 observations. Standard errors are Newey-West with 17 lags.

Table A8: Pass-Through of Henry Hub to Retail Natural Gas Prices, Full Results

	Residential	Commercial	Industrial	Electric power
Henry Hub price$_t$	0.10	0.11	0.16	0.31
	(0.03)	(0.02)	(0.02)	(0.04)
Henry Hub price$_{t-1}$	0.27	0.26	0.26	0.25
	(0.03)	(0.02)	(0.03)	(0.05)
Henry Hub price$_{t-2}$	-0.13	-0.14	-0.16	-0.36
	(0.03)	(0.02)	(0.03)	(0.06)
Henry Hub price$_{t-3}$	-0.04	-0.04	-0.07	-0.01
	(0.03)	(0.02)	(0.02)	(0.04)
Henry Hub price$_{t-4}$	0.00	-0.02	0.03	0.04
	(0.03)	(0.02)	(0.02)	(0.04)
Henry Hub price$_{t-5}$	-0.01	-0.01	-0.02	-0.04
	(0.03)	(0.02)	(0.02)	(0.03)
Henry Hub price$_{t-6}$	0.02	0.02	0.04	0.10
	(0.04)	(0.02)	(0.02)	(0.04)
Henry Hub price$_{t-7}$	0.00	0.00	-0.02	-0.04
	(0.04)	(0.02)	(0.02)	(0.03)
Henry Hub price$_{t-8}$	0.04	0.03	0.01	0.03
	(0.04)	(0.02)	(0.02)	(0.03)
Henry Hub price$_{t-9}$	-0.02	-0.03	0.00	-0.02
	(0.05)	(0.02)	(0.02)	(0.03)
Henry Hub price$_{t-10}$	-0.01	0.00	-0.02	-0.02
	(0.04)	(0.02)	(0.02)	(0.04)
Henry Hub price$_{t-11}$	0.03	0.03	0.04	0.04
	(0.04)	(0.02)	(0.02)	(0.04)
y_{t-1}	0.77	0.81	0.73	0.71
	(0.02)	(0.02)	(0.02)	(0.02)
Observations	6912	6912	6912	6912
Implied long-run price	1.18	1.08	1.00	0.94
	(0.19)	(0.11)	(0.08)	(0.12)

Note: Data are monthly from 2002 to 2013, and are at the state level. The dependent variable is the sector-level retail price, in levels. As described in the text, the electric power price we use is the citygate price. The long-run price elasticity is calculated as the sum of the coefficients on prices with lags zero through eleven, divided by (one minus the coefficient on y_{t-1}). All specifications control for year effects and state by month-of-year effects. Standard errors are clustered by sample month.

Table A9: Pass-Through of Henry Hub to Retail Natural Gas Prices, 2SLS Specification

	Residential	Commercial	Industrial	Electric power
Henry Hub price$_t$	0.23	0.29	0.33	0.64
	(0.08)	(0.06)	(0.07)	(0.14)
y_{t-1}	0.77	0.72	0.67	0.38
	(0.05)	(0.05)	(0.05)	(0.11)
Observations	6912	6912	6912	6912
Implied long-run price	0.99	1.03	0.99	1.02
	(0.14)	(0.07)	(0.08)	(0.06)
First-stage F	5.56	8.31	8.10	5.17

Note: Data are monthly from 2002 to 2013, and are at the state level. The dependent variable is the sector-level retail price, in levels. As described in the text, the electric power price we use is the citygate price. The long-run price elasticity is calculated as the coefficient on the Henry Hub price, divided by (one minus the coefficient on y_{t-1}). The instruments for the price variable are population-weighted lagged national heating degree days and cooling degree days. All specifications control for current and one-month lagged own-state HDDs and CDDs, state by month-of-year effects, and a linear time trend. Standard errors are two-way clustered by sample month and state.

Table A10: Employment Regressions

	(1)	(2)	(3)	(4)
Gas intensity	1.25	0.93	1.00	1.45
	(0.77)	(0.70)	(0.67)	(1.12)
Log employment, 2002	-0.32	-0.42	-0.42	-0.32
	(0.06)	(0.06)	(0.06)	(0.07)
Log employment, 2007	1.31	1.39	1.39	1.31
	(0.06)	(0.06)	(0.06)	(0.07)
Constant	-0.03	0.15	0.17	0.03
	(0.14)	(0.14)	(0.14)	(0.15)
NAICS-2 effects		Y		
NAICS-3 effects	Y			Y
Weighting by output	Y	Y	Y	
Weighting by 2007 employment				Y
Observations	229	229	229	229

Note: Data are at the 6-digit NAICS level and represent the manufacturing industry (NAICS 31-33). The dependent variable is log employment in 2012.

A1.3 Climate Change Impacts Calculations

Here we give the parameters assumed for the calculations in section 6.1. In our estimated counterfactual, quantity produced increases by 6173 bcf/year, and quantity consumed increases by 4132 bcf/year; the difference comes from a reduction in net imports. For our "high" case, we use 6173, and for our "low" case, we use 4132. Of the 4132 bcf/year, 2441 is in the residential, commercial and industrial sectors, and 1691 is in the electric power sector.

Parameters

- Heat content of natural gas: 1.025 mmBtu per mcf.[49]
- Carbon content of fuels: 117.08 pounds CO_2 per mmBtu for natural gas and 212.7 pounds CO_2 per mmBtu for coal.[50]
- Social cost of carbon: 39 $(2011)/metric ton, or 40 $(2013)/metric ton. Source: Interagency Working Group on Social Cost of Carbon, United States Government.[51]
- Gross methane leak rate: 0.42% (low case) to 7.9% (high case).[52]
- Mass of methane in one bcf of dry gas at standard temperature and pressure: 20,602 metric tons per bcf.[53]
- Methane global warming potential, 100-year (GWP): 34.[54]
- Average heat rate of power plants: 10416 Btu per kWh for natural gas and 10107 Btu per kWh for coal.[55]

High Case Calculations

- High case: increase in CO_2 emissions from increased combustion of natural gas:

$$= \frac{6173\text{bcf}}{\text{year}} \cdot \frac{1025 \cdot 10^9\text{Btu}}{\text{bcf}} \cdot \frac{117.08 \cdot 10^3 \text{ lbs } CO_2}{10^9 \text{ Btu}} \cdot \frac{\text{ton}}{2205 \text{ lbs}} \cdot \frac{40\$}{\text{ton } CO_2}$$

= +13 billion dollars per year

[49] http://www.eia.gov/tools/faqs/faq.cfm?id=45&t=8

[50] http://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11

[51] http://www.epa.gov/climatechange/EPAactivities/economics/scc.html

[52] Low case: Allen et al. (2013). High case: Howarth (2014).

[53] http://agnatural.pt/documentos/ver/natural-gas-conversion-pocketbook fec0aeed1d2e6a84b27445ef 096963a7eebab0a2.pdf. Calculations: 1 metric ton of LNG = 1300 cubic meters of gas at normal temperature and pressure (0 °C, 1 atmosphere pressure). Convert to standard temperature and pressure (60 °F, 1 atmosphere pressure) by multiplying by 1,163 Btu/cf and dividing by 1,100 Btu/cf. Thus, 1 metric ton equals 1300 * 35.315 cf/cm * 1163 / 1100 = 48,538 cf of dry gas at STP. Inverting yields 20,602 metric tons of gas per bcf.

[54] http://www.climatechange2013.org/images/report/WG1AR5 Chapter08 FINAL.pdf

[55] http://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11

- High case: increase in methane emissions from increased extraction of natural gas:

$$= \frac{6173\ \text{bcf}}{\text{year}} \cdot \frac{0.079}{1-0.079} \cdot \frac{20602\ \text{tons}}{\text{bcf}} \cdot 34\ \text{GWP} \cdot \frac{40\$}{\text{ton}}$$

  = +15 billion dollars per year

- Total, high case: +28 billion dollars per year

Low Case Calculations

- Low case: increase in CO_2 emissions from increased natural gas combustion in residential, commercial, industrial, and electric power sectors:

$$= \frac{4132\ \text{bcf}}{\text{year}} \cdot \frac{1025 \cdot 10^9\ \text{Btu}}{\text{bcf}} \cdot \frac{117.08 \cdot 10^3\ \text{lbs}\ CO_2}{10^9\ \text{Btu}} \cdot \frac{\text{ton}}{2205\ \text{lbs}} \cdot \frac{40\$}{\text{ton}}$$

  = +9.0 billion dollars per year (of which the electric power sector contributes $3.7 billion per year)

- Low case: decrease in CO_2 emissions from displaced coal in electric power sector:

$$= \frac{1691\ \text{bcf}}{\text{year}} \cdot \frac{1025 \cdot 10^3\ \text{mmBtu}}{\text{bcf}} \cdot \frac{\text{kWh}}{10416\ \text{Btu(gas)}} \cdot \frac{10107\ \text{Btu(coal)}}{\text{kWh}} \cdot \frac{212.7\ \text{lbs}\ CO_2}{\text{mmBtu(coal)}} \cdot \frac{\text{tons}}{2205\ \text{lbs}} \cdot \frac{40\$}{\text{ton}}$$

  = -6.5 billion dollars per year

- Low case: increase in methane emissions from increased extraction of natural gas:

$$= \frac{4132\ \text{bcf}}{\text{year}} \cdot \frac{0.0042}{1-0.0042} \cdot \frac{20602\ \text{tons}}{\text{bcf}} \cdot 34\ \text{GWP} \cdot \frac{40\$}{\text{ton}}$$

  = +0.5 billion dollars per year

- Total, low case: +3.0 billion dollars per year