Attachment N

Natural Gas Supply Curves
and Transportation and Seasonal Adders in v.2.1.6

IPM v.2.1.6, like the previous IPM v. 2.1, uses supply curves to provide a price-quantity relationship for natural gas supplies in the United States. The v.2.1.6 gas supply curves are shown in Table N1. They were derived using the North American Natural Gas Analysis System (NANGAS), a detail-rich natural gas model developed by ICF Consulting, Inc. NANGAS is based on the Gas System Analysis Model (GSAM), a model currently maintained and used at the Strategic Center for Natural Gas (SCNG) at the U.S. Department of Energy (DOE). GSAM was used to generate the gas supply curves for v.2.1. NANGAS adds computer programming logic and data improvements to GSAM to better capture the interplay of demand- and supply-side factors on natural gas supply.

The supply curves contained in Table N1 specify annual price and volume relationships at the Henry Hub.[1] The impact on prices of demand for natural gas from the non-electric sector is also accounted for in the supply curves. These curves are derived from a series of NANGAS runs, where natural gas supply, demand, and transportation are equilibrated under a variety of electricity growth rate assumptions. A separate supply curve is provided for each IPM model run year.

V.2.1.6 includes explicit transportation and seasonal adders to reflect the cost of moving gas from the source to the plant and to account for the seasonality in gas prices.

Table N2 shows the v.2.1.6 transportation differentials for each IPM model region relative to the Henry Hub price. These transportation differentials were produced by analyzing daily gas price data for key pricing points in North America as reported in the Platts (McGraw-Hill) publication "Gas Daily". The key natural gas pricing points were mapped into IPM regions to produce the average annual differentials shown in Table N2.

Table N3 shows the seasonal gas adders used in the v.2.1.6. The values were derived from daily price data for key pricing points as reported in the Platts (McGraw-Hill) publication "Gas Daily". The seasonal adders in Table N3 are used to distinguish summer and winter delivered gas prices. Seasonal gas adders vary by IPM model region. In general, seasonal gas adders for winter are higher than those for summer. In winter, due to lower temperatures, there is higher demand for gas by the residential sector for space heating. This results in higher gas pipeline utilization and higher delivered gas prices.

In v.2.1.6, plants using natural gas for electric generation face market clearing prices. This price is endogenously determined in IPM by equating demand and supply. In every IPM run, the market clearing price and transportation and seasonal cost adders all enter into the calculation of total expenditures on natural gas consumption for electric generation. Table N4 shows the Henry Hub and national average delivered natural gas prices resulting under the v.2.1.6 Base Case. Table N5 shows the Henry Hub and national average delivered prices resulting under the v.2.1.6 Clear Skies Case.

Notes

1. The Henry Hub is a gas pipeline junction in Louisiana, which interconnects with nine interstate and four intrastate pipelines and offers shippers access to pipelines that have markets in U.S. Gulf Coast, Southeast, Midwest, and Northeast regions. Due to the Hub's strategic centralized location, the price of natural gas at the Henry Hub serves as the generally accepted reference point for U.S. natural gas trading.

Table N1. EPA v.2.1.6 Gas Supply Curves

YEAR	PRICE (1999 $/MMBtu)	Non Electric Gas Demand (Tbtu)	Total Gas Supply (Tbtu)
2005	2.39	19553	23250
2005	2.44	19494	23330
2005	2.49	19436	23410
2005	2.54	19380	23490
2005	2.58	19325	23570
2005	2.63	19271	23650
2005	2.68	19218	23730
2005	2.73	19166	23810
2005	2.77	19115	23890
2005	2.82	19065	23960
2005	2.87	19016	24030
2005	2.92	18968	24100
2005	2.96	18928	24160
2005	2.97	18922	24170
2005	3.01	18879	24260
2005	3.04	18855	24310
2005	3.06	18836	24340
2005	3.11	18793	24420
2005	3.16	18750	24500
2005	3.2	18707	24580
2005	3.21	18707	24580
2005	3.25	18664	24620
2005	3.3	18621	24660
2005	3.35	18578	24700
2005	3.39	18542	24740
2005	3.4	18536	24750
2005	3.44	18497	24810
2005	3.49	18458	24870
2005	3.54	18420	24930
2005	3.59	18382	24990
2005	3.64	18345	25050
2005	3.68	18309	25110
2005	3.73	18273	25170
2005	3.78	18238	25230
2005	3.83	18203	25290
2005	3.87	18169	25350
2005	3.92	18135	25410
2005	3.97	18102	25470
2005	4.02	18069	25530
2005	4.07	18036	25580
2005	4.11	18004	25630
2005	4.16	17972	25680
2005	4.21	17941	25730
2005	4.26	17910	25780
2005	4.31	17880	25830
2005	4.35	17850	25880
2005	4.4	17820	25930
2005	4.45	17791	25980
2005	4.5	17762	26030
2005	4.54	17733	26080
2005	4.59	17705	26130
2005	4.64	17677	26180
2005	4.69	17649	26230
2005	4.74	17622	26280
2005	4.78	17595	26330

Table N1. EPA v.2.1.6 Gas Supply Curves

YEAR	PRICE (1999 $/MMBtu)	Non Electric Gas Demand (Tbtu)	Total Gas Supply (Tbtu)
2010	2.39	20693	25670
2010	2.44	20640	25780
2010	2.49	20588	25890
2010	2.54	20537	26000
2010	2.58	20487	26110
2010	2.63	20438	26220
2010	2.68	20390	26330
2010	2.73	20343	26430
2010	2.77	20297	26530
2010	2.82	20252	26630
2010	2.87	20208	26730
2010	2.89	20192	26770
2010	2.92	20170	26820
2010	2.97	20135	26900
2010	3.01	20100	26980
2010	3.06	20065	27060
2010	3.09	20043	27110
2010	3.11	20029	27140
2010	3.16	19990	27220
2010	3.21	19951	27300
2010	3.25	19912	27380
2010	3.3	19873	27460
2010	3.35	19834	27540
2010	3.4	19795	27620
2010	3.44	19756	27700
2010	3.49	19717	27780
2010	3.54	19678	27860
2010	3.58	19643	27930
2010	3.59	19640	27950
2010	3.64	19607	28170
2010	3.68	19574	28390
2010	3.7	19566	28450
2010	3.73	19542	28510
2010	3.78	19510	28590
2010	3.83	19478	28670
2010	3.87	19447	28750
2010	3.92	19416	28830
2010	3.97	19386	28910
2010	4.02	19356	28990
2010	4.07	19326	29070
2010	4.11	19297	29150
2010	4.16	19268	29220
2010	4.21	19239	29290
2010	4.26	19211	29360
2010	4.31	19183	29430
2010	4.35	19156	29500
2010	4.4	19129	29570
2010	4.45	19102	29640
2010	4.5	19076	29710
2010	4.54	19050	29780
2010	4.59	19024	29850
2010	4.64	18998	29920
2010	4.69	18973	29990
2010	4.74	18948	30060
2010	4.78	18923	30130

Table N1. EPA v.2.1.6 Gas Supply Curves

YEAR	PRICE (1999 $/MMBtu)	Non Electric Gas Demand (Tbtu)	Total Gas Supply (Tbtu)
2015	2.39	21877	25540
2015	2.44	21845	25910
2015	2.49	21813	26280
2015	2.54	21782	26650
2015	2.58	21751	27020
2015	2.63	21721	27390
2015	2.68	21692	27750
2015	2.73	21663	28110
2015	2.77	21635	28470
2015	2.82	21607	28830
2015	2.87	21580	29190
2015	2.89	21570	29320
2015	2.92	21567	29820
2015	2.96	21564	30500
2015	2.97	21560	30540
2015	3.01	21535	30810
2015	3.06	21510	31080
2015	3.11	21485	31350
2015	3.16	21460	31620
2015	3.21	21435	31890
2015	3.24	21419	32060
2015	3.25	21407	32190
2015	3.3	21375	32560
2015	3.35	21343	32930
2015	3.37	21330	33080
2015	3.4	21317	33280
2015	3.44	21295	33620
2015	3.49	21273	33960
2015	3.54	21251	34300
2015	3.59	21230	34640
2015	3.64	21209	34980
2015	3.68	21188	35310
2015	3.73	21168	35640
2015	3.78	21148	35970
2015	3.83	21128	36300
2015	3.87	21108	36630
2015	3.92	21089	36960
2015	3.97	21070	37290
2015	4.02	21051	37620
2015	4.07	21032	37950
2015	4.11	21014	38270
2015	4.16	20996	38590
2015	4.21	20978	38910
2015	4.26	20960	39230
2015	4.31	20942	39550
2015	4.35	20925	39870
2015	4.4	20908	40190
2015	4.45	20891	40510
2015	4.5	20874	40830
2015	4.54	20857	41150
2015	4.59	20841	41460
2015	4.64	20825	41770
2015	4.69	20809	42080
2015	4.74	20793	42390
2015	4.78	20777	42700

Table N1. EPA v.2.1.6 Gas Supply Curves

YEAR	PRICE (1999 $/MMBtu)	Non Electric Gas Demand (Tbtu)	Total Gas Supply (Tbtu)
2020	2.39	23378	30070
2020	2.44	23338	30470
2020	2.49	23299	30870
2020	2.54	23260	31260
2020	2.58	23222	31650
2020	2.63	23185	32040
2020	2.66	23161	32290
2020	2.68	23154	32440
2020	2.73	23132	32900
2020	2.77	23110	33360
2020	2.82	23088	33820
2020	2.87	23066	34280
2020	2.88	23063	34350
2020	2.92	23033	34660
2020	2.97	22997	35030
2020	3.01	22961	35400
2020	3.06	22925	35770
2020	3.08	22910	35930
2020	3.11	22887	36080
2020	3.16	22846	36340
2020	3.21	22805	36600
2020	3.25	22764	36860
2020	3.27	22753	36930
2020	3.3	22732	37190
2020	3.35	22704	37550
2020	3.4	22676	37910
2020	3.44	22648	38260
2020	3.49	22621	38610
2020	3.54	22594	38960
2020	3.59	22568	39310
2020	3.64	22542	39660
2020	3.68	22516	40010
2020	3.73	22491	40350
2020	3.78	22466	40690
2020	3.83	22441	41030
2020	3.87	22417	41370
2020	3.92	22393	41710
2020	3.97	22369	42050
2020	4.02	22346	42390
2020	4.07	22323	42720
2020	4.11	22300	43050
2020	4.16	22278	43380
2020	4.21	22256	43710
2020	4.26	22234	44040
2020	4.31	22212	44370
2020	4.35	22191	44700
2020	4.4	22170	45030
2020	4.45	22149	45350
2020	4.5	22128	45670
2020	4.54	22108	45990
2020	4.59	22088	46310
2020	4.64	22068	46630
2020	4.69	22048	46950
2020	4.74	22029	47270
2020	4.78	22010	47590

Table N1. EPA v.2.1.6 Gas Supply Curves

YEAR	PRICE (1999 $/MMBtu)	Non Electric Gas Demand (Tbtu)	Total Gas Supply (Tbtu)
2025	2.39	24629	18890
2025	2.44	24593	19710
2025	2.49	24558	20550
2025	2.54	24524	21400
2025	2.58	24491	22270
2025	2.63	24458	23160
2025	2.68	24426	24070
2025	2.73	24394	24990
2025	2.77	24363	25930
2025	2.82	24333	26890
2025	2.87	24303	27870
2025	2.92	24274	28860
2025	2.97	24245	29870
2025	3.01	24217	30900
2025	3.06	24189	31950
2025	3.11	24162	33010
2025	3.16	24135	34090
2025	3.18	24120	34710
2025	3.21	24118	35850
2025	3.24	24115	37510
2025	3.25	24109	37650
2025	3.3	24094	38040
2025	3.34	24082	38340
2025	3.32	24000	38800
2025	3.35	23983	39560
2025	3.4	23958	40730
2025	3.44	23934	41920
2025	3.49	23910	43130
2025	3.54	23886	44350
2025	3.59	23863	45590
2025	3.64	23840	46850
2025	3.68	23817	48130
2025	3.73	23795	49430
2025	3.78	23773	50740
2025	3.83	23751	52070
2025	3.87	23729	53420
2025	3.92	23708	54790
2025	3.97	23687	56180
2025	4.02	23666	57580
2025	4.07	23646	59000
2025	4.11	23626	60440
2025	4.16	23606	61900
2025	4.21	23586	63380
2025	4.26	23567	64870
2025	4.31	23548	66380
2025	4.35	23529	67910
2025	4.4	23510	69460
2025	4.45	23491	71030
2025	4.5	23473	72620
2025	4.54	23455	74220
2025	4.59	23437	75840
2025	4.64	23419	77480
2025	4.69	23401	79140
2025	4.74	23384	80820
2025	4.78	23367	82520

Table N2. Transportation Differentials for EPA Base Case 2.1.6 (1999 cents/MMBtu)

	ECAO	MANO	MECS	MACE	MACW	MACS	MAPP	LILC	NENG	VACA	TVA	UPNY	NYC
2005	19.10	9.57	13.40	31.60	36.40	31.60	-17.00	40.20	36.40	38.30	3.83	17.20	66.00
2010	19.10	9.57	13.40	31.60	36.40	31.60	-17.00	40.20	36.40	38.30	3.83	17.20	66.00
2015	19.10	9.57	13.40	31.60	36.40	31.60	-17.00	40.20	36.40	38.30	3.83	17.20	66.00
2020	19.10	9.57	13.40	31.60	36.40	31.60	-17.00	40.20	36.40	38.30	3.83	17.20	66.00

	DSNY	WUMS	ENTG	SOU	SPPN	SPPS	FRCC	ERCT	RMPA	NWPE	AZNM	PNW	CALI
2005	32.50	8.61	1.91	1.91	-19.00	-17.00	29.70	-12.00	-34.00	-47.00	-15.00	-36.00	17.20
2010	32.50	8.61	1.91	1.91	-19.00	-17.00	29.70	-12.00	-34.00	-47.00	-15.00	-36.00	17.20
2015	32.50	8.61	1.91	1.91	-19.00	-17.00	29.70	-12.00	-34.00	-47.00	-15.00	-36.00	17.20
2020	32.50	8.61	1.91	1.91	-19.00	-17.00	29.70	-12.00	-34.00	-47.00	-15.00	-36.00	17.20

Note: This is an update of Table A8.6 that appears in *Documentation of EPA Modeling Applications (V.2.1) Using the Integrated Planning Mode*.

Table N3. Seasonal Gas Price Adders in EPA Base Case 2.1.6 (1999 cents/MMBtu

Winter	ECAO	MANO	MECS	MACE	MACW	MACS	MAPP	LILC	NENG	VACA	TVA	UPNY	NYC
2005	1.91	1.91	0.00	5.74	5.74	4.78	2.87	9.57	7.65	7.65	0.00	3.83	7.65
2010	1.91	1.91	0.00	5.74	5.74	4.78	2.87	9.57	7.65	7.65	0.00	3.83	7.65
2015	1.91	1.91	0.00	5.74	5.74	4.78	2.87	9.57	7.65	7.65	0.00	3.83	7.65
2020	1.91	1.91	0.00	5.74	5.74	4.78	2.87	9.57	7.65	7.65	0.00	3.83	7.65

Summer	ECAO	MANO	MECS	MACE	MACW	MACS	MAPP	LILC	NENG	VACA	TVA	UPNY	NYC
2005	-2.90	-2.90	0.00	-7.70	-7.70	-6.70	-3.80	-10.50	-7.70	-9.60	0.00	-5.70	-10.50
2010	-2.90	-2.90	0.00	-7.70	-7.70	-6.70	-3.80	-10.50	-7.70	-9.60	0.00	-5.70	-10.50
2015	-2.90	-2.90	0.00	-7.70	-7.70	-6.70	-3.80	-10.50	-7.70	-9.60	0.00	-5.70	-10.50
2020	-2.90	-2.90	0.00	-7.70	-7.70	-6.70	-3.80	-10.50	-7.70	-9.60	0.00	-5.70	-10.50

Winter	DSNY	WUMS	ENTG	SOU	SPPN	SPPS	FRCC	ERCT	RMPA	NWPE	AZNM	PNW	CALI
2005	7.65	1.91	0.00	-1.00	0.96	0.96	-5.70	-1.90	8.61	22.96	0.00	10.52	-3.80
2010	7.65	1.91	0.00	-1.00	0.96	0.96	-5.70	-1.90	8.61	22.96	0.00	10.52	-3.80
2015	7.65	1.91	0.00	-1.00	0.96	0.96	-5.70	-1.90	8.61	22.96	0.00	10.52	-3.80
2020	7.65	1.91	0.00	-1.00	0.96	0.96	-5.70	-1.90	8.61	22.96	0.00	10.52	-3.80

Summer	DSNY	WUMS	ENTG	SOU	SPPN	SPPS	FRCC	ERCT	RMPA	NWPE	AZNM	PNW	CALI
2005	-7.70	-1.90	0.00	0.00	0.00	-1.00	5.74	2.87	-12.40	-26.80	0.00	-13.40	4.78
2010	-7.70	-1.90	0.00	0.00	0.00	-1.00	5.74	2.87	-12.40	-26.80	0.00	-13.40	4.78
2015	-7.70	-1.90	0.00	0.00	0.00	-1.00	5.74	2.87	-12.40	-26.80	0.00	-13.40	4.78
2020	-7.70	-1.90	0.00	0.00	0.00	-1.00	5.74	2.87	-12.40	-26.80	0.00	-13.40	4.78

Note: This is an update of Table A8.7 that appears in *Documentation of EPA Modeling Applications (V.2.1) Using the Integrated Planning Mode*.

Table N4. US Wellhead and National Average Delivered Natural Gas Prices in EPA Base Case, v.2.1.6 (1999 $/mmBtu)

Year	Wellhead Gas Price (at Henry Hub)	Delivered Gas Price
2005	2.89	2.95
2010	2.97	3.03
2015	2.96	3.03
2020	2.87	2.94

Note: This is an update of Table 8.8 that appears in *Documentation of EPA Modeling Applications (V.2.1) Using the Integrated Planning Model* .

Table N5. US Wellhead and National Average Delivered Natural Gas Prices in EPA Clear Skies Case, v.2.1.6 (1999 $/mmBtu)

Year	Wellhead Gas Price (at Henry Hub)	Delivered Gas Price
2005	2.96	3.02
2010	3.11	3.17
2015	3.01	3.08
2020	2.94	3.01