TECHNICAL APPENDIX

MODELING DATA INPUT, MODELING METHODOLOGY, AND MODELING RESULTS

A.1 MODELING DATA INPUT

Projected energy resource development in the PRB is the major set of economic forces driving the cumulative analysis in this study. The assumptions used in the socioeconomics analysis for this study regarding such development are presented in the Task 2 Report of the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (ENSR 2005b) or based on the associated database, with the following exceptions:

- Total coal production data for reporting years (2010, 2015, and 2020) were based on the Task 2 report (ENSR 2005b). Between reporting years, production data were determined through linear interpolation to facilitate fiscal modeling.

- Based on the location of existing and potential future coal reserves in Campbell and Converse counties, production from areas within each of the two counties would vary over time, which in turn, would have implications for future ad valorem property taxes accruing to the respective counties and school districts. The allocations of coal production between Campbell and Converse counties reflect assumptions regarding the rate and location of projected future production, which may or may not be consistent with those of the operator. However, the overall totals are consistent with the production projections outlined in the Task 2 report (ENSR 2005b).

- The CBNG well projections for this study were being refined concurrently with the REMI modeling conducted for this report. As a result, the initial well numbers, as used in the REMI model and shown in this Appendix, differ somewhat from the final well numbers in the Task 2 database (ENSR 2005b). However, as noted in the main text of this report, the differences in potential impacts would be relatively minor in magnitude in any given time period and would tend to be somewhat offsetting when considered over the entire analysis period (2003 through 2020).

- The CBNG production projections for this study were being refined concurrently with the REMI modeling conducted for this report. As a result, the initial production numbers, as used in the REMI model and shown in this Appendix, differ somewhat from the final annual production projections in the Task 2 report and database (ENSR 2005b). As noted in the main text of this report, the cumulative differences, considering the value of coal and conventional oil and gas would be moderate; however, it would not be substantial in terms of the relative orders of magnitude of revenues that would be generated.

- Projected CBNG production for the socioeconomic analysis assumed an average life-of-well production of 234 mmcf per well.

- Due to the concurrent refinement of the Task 2 database and the REMI modeling conducted for this report, the projected levels of annual conventional oil and gas production used in the socioeconomic analysis (as shown in this Appendix) reflect an initial set of development assumptions that differ from those in the final Task 2 report (ENSR 2005b). As discussed in the main body of this report, the differences do not materially alter the anticipated impacts or conclusions of the overall socioeconomic assessment, but rather, they primarily affect the projected timing of anticipated tax revenues.

- Employment data include coal mine-related employment from the Task 2 database (for reporting years 2010, 2015, and 2020), plus allowances for other mining and oil and gas sectors as developed for the socioeconomic analysis. Between reporting years, data were determined through linear interpolation.

- The socioeconomic analysis estimated future coal mining employment for the upper production scenario based on productivity improvements comparable to those assumed for the lower production scenario. This assumption represents a departure from the more aggressive productivity assumptions developed in Task 2 (ENSR 2005b), whereby the higher production was achieved with little additional employment. Although such productivity increases may be realized, this analysis adopted the more conservative approach as a means of assessing the potential implications of higher employment growth on social and economic conditions.

The assumptions used in the socioeconomics analysis are summarized in this appendix in **Tables A–1** through **A–9**, and **Figures A–1** to **A-5**. In terms of resource development, only the level of future coal production varies between the upper and lower production scenarios, although an additional power plant also is included in the upper production scenario.

Table A-1
Projected Annual Coal Production by County Under the Lower and Upper Production Scenarios[1]
(mmtpy)

Year	Campbell	Converse	Sheridan	Total
Lower Production Scenario				
2005	364	21	0	385
2006	370	21	0	391
2007	375	21	0	396
2008	381	21	0	402
2009	386	21	0	407
2010	409	2	5	416
2011	419	2	5	426
2012	429	2	6	437
2013	439	2	7	448
2014	449	2	8	459
2015	461	6	9	476
2016	467	6	9	482
2017	473	6	10	489
2018	479	6	11	496
2019	485	6	12	503
2020	489	6	13	508
Upper Production Scenario				
2005	397	21	0	418
2006	409	21	0	430
2007	421	21	0	442
2008	433	21	0	454
2009	445	21	0	466
2010	477	2	5	484
2011	489	2	6	497
2012	501	2	7	510
2013	514	2	8	523
2014	527	2	9	537
2015	522	21	10	553
2016	528	21	11	560
2017	534	21	12	567
2018	541	21	13	574
2019	548	21	14	581
2020	555	21	15	591

Table A-2
New CBNG Wells Drilled Between 2005 and 2020 by Mineral Ownership and County

County	Mineral Ownership			Total
	Federal	State	Fee	
Numbers of New CBNG Wells Drilled				
Campbell	19,676	1,543	10,219	31,497
Converse	167	32	62	260
Johnson	11,333	1,153	3,434	15,941
Sheridan	3,751	1,347	5,495	10,515
Total Wells	**34,928**	**4,075**	**19,210**	**58,213**
Percent Distribution of New CBNG Wells				
Campbell	33.8	2.7	17.6	54.1
Converse	0.3	0.1	0.1	0.4
Johnson	19.5	2.0	5.9	27.4
Sheridan	6.4	2.3	9.4	18.1
Totals	**60.0**	**7.0**	**33.0**	**100.0**

Table A-3
Number of Producing CBNG Wells by County from 2005 through 2020

Year	County				Total
	Campbell	Converse	Johnson	Sheridan	
2005	13,867	880	2,305	2,630	19,681
2006	15,698	893	3,248	3,249	23,087
2007	17,496	902	4,192	3,864	26,452
2008	19,286	910	5,138	4,478	29,811
2009	21,009	914	6,080	5,083	33,083
2010	22,610	907	7,012	5,669	36,196
2011	24,156	895	7,942	6,247	39,239
2012	24,558	801	8,747	6,637	40,743
2013	23,412	594	9,383	6,770	40,159
2014	23,023	441	10,111	7,033	40,607
2015	23,703	363	10,969	7,478	42,512
2016	24,701	307	11,870	7,979	44,856
2017	25,130	208	12,718	8,390	46,446
2018	25,333	209	12,821	8,457	46,821
2019	25,574	211	12,943	8,538	47,266
2020	25,873	214	13,094	8,638	47,819

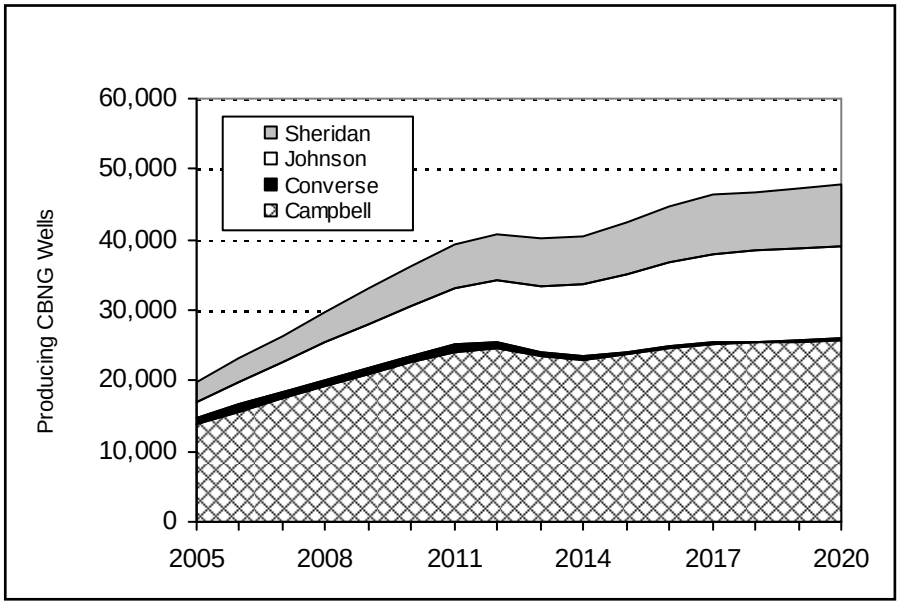
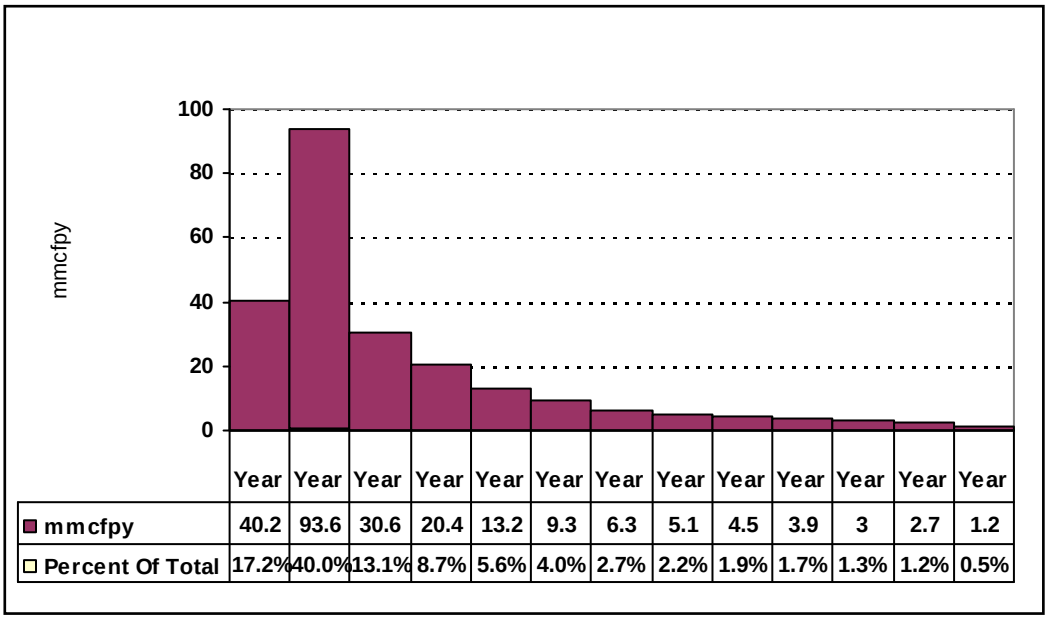


Figure A-1. Producing CBNG Wells by County



	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year	Year
mmcfpy	40.2	93.6	30.6	20.4	13.2	9.3	6.3	5.1	4.5	3.9	3	2.7	1.2
Percent Of Total	17.2%	40.0%	13.1%	8.7%	5.6%	4.0%	2.7%	2.2%	1.9%	1.7%	1.3%	1.2%	0.5%

Figure A-2. Typical CBNG Well Production by Year

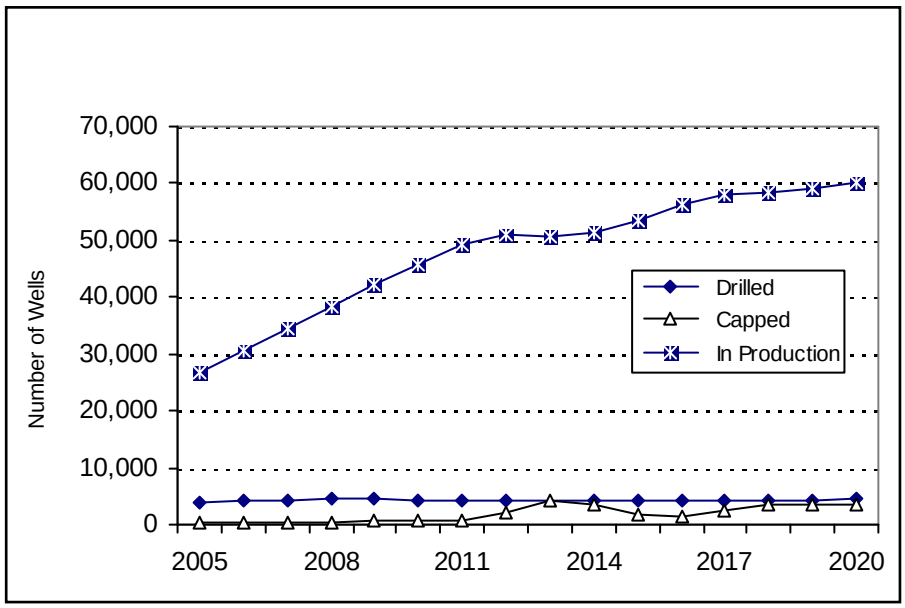


Figure A-3. Summary of Conventional Oil and Gas and CBNG Well Development in the PRB

Table A-4
Projected CBNG Production
(mmcfpy)

Year	Campbell County			Converse County			Johnson County			Sheridan County			4-County Total		
	Existing Wells	New Wells	Total	Existing Wells	New Wells	Total	Existing Wells	New Wells	Total	Existing Wells	New Wells	Total	Existing Wells	New Wells	Total
2005	232,861	75,042	307,903	14,645	620	15,265	18,568	37,979	56,547	35,236	25,053	60,289	301,310	138,694	440,004
2006	115,623	250,067	365,690	7,272	2,066	9,338	9,219	126,559	135,778	17,496	83,485	100,981	149,610	462,177	611,787
2007	81,549	308,257	389,806	5,129	2,547	7,676	6,502	156,010	162,512	12,340	102,912	115,252	105,520	569,725	675,245
2008	60,211	347,736	407,947	3,787	2,873	6,660	4,801	175,990	180,791	9,111	116,092	125,203	77,910	642,691	720,601
2009	46,764	373,971	420,735	2,941	3,090	6,031	3,729	189,268	192,997	7,076	124,850	131,926	60,510	691,179	751,689
2010	36,509	393,128	429,637	2,296	3,248	5,544	2,911	198,963	201,874	5,524	131,246	136,770	47,240	726,585	773,825
2011	28,989	406,983	435,972	1,823	3,363	5,186	2,311	205,976	208,287	4,387	135,871	140,258	37,510	752,193	789,703
2012	20,774	418,836	439,610	1,306	3,461	4,767	1,656	211,974	213,630	3,143	139,828	142,971	26,880	774,099	800,979
2013	12,922	429,878	442,800	813	3,552	4,365	1,030	217,563	218,593	1,955	143,515	145,470	16,720	794,507	811,227
2014	7,520	440,197	447,717	473	3,637	4,110	600	222,785	223,385	1,138	146,960	148,098	9,730	813,580	823,310
2015	4,583	449,226	453,809	288	3,712	4,000	365	227,355	227,720	693	149,974	150,667	5,930	830,267	836,197
2016	1,592	458,181	459,773	100	3,786	3,886	127	231,887	232,014	241	152,963	153,204	2,060	846,817	848,877
2017	-	465,109	465,109	-	3,843	3,843	-	235,393	235,393	-	155,277	155,277	-	859,622	859,622
2018	-	470,771	470,771	-	3,890	3,890	-	238,259	238,259	-	157,167	157,167	-	870,086	870,086
2019	-	477,806	477,806	-	3,948	3,948	-	241,819	241,819	-	159,515	159,515	-	883,089	883,089
2020	-	487,183	487,183	-	4,026	4,026	-	246,565	246,565	-	162,646	162,646	-	900,420	900,420

Table A-5
Projected Conventional Gas Production by County
(mmcfpy)

Year	County				Total
	Campbell	Converse	Johnson	Sheridan	
2005	16,980	18,720	1,840	240	37,780
2006	17,440	19,240	1,840	250	38,770
2007	17,900	19,760	1,840	260	39,760
2008	18,360	20,280	1,840	270	40,750
2009	18,820	20,800	1,840	280	41,740
2010	19,290	21,340	1,840	280	42,750
2011	18,950	20,950	1,810	270	41,980
2012	18,610	20,560	1,780	260	41,210
2013	18,270	20,170	1,750	250	40,440
2014	17,930	19,780	1,720	240	39,670
2015	17,570	19,410	1,680	250	38,910
2016	17,230	19,020	1,650	240	38,140
2017	16,890	18,630	1,620	230	37,370
2018	16,550	18,240	1,590	220	36,600
2019	16,210	17,850	1,560	210	35,830
2020	15,870	17,480	1,530	220	35,100

Table A-6
Projected Oil Production by County
(barrels)

Year	County				Total
	Campbell	Converse	Johnson	Sheridan	
2005	10,541,000	1,172,000	1,000,000	142,000	12,855,000
2006	10,780,600	1,194,800	1,022,200	145,000	13,142,600
2007	11,020,200	1,217,600	1,044,400	148,000	13,430,200
2008	11,259,800	1,240,400	1,066,600	151,000	13,717,800
2009	11,499,400	1,263,200	1,088,800	154,000	14,005,400
2010	11,739,000	1,286,000	1,111,000	157,000	14,293,000
2011	11,979,200	1,308,600	1,133,800	160,000	14,581,600
2012	12,219,400	1,331,200	1,156,600	163,000	14,870,200
2013	12,459,600	1,353,800	1,179,400	166,000	15,158,800
2014	12,699,800	1,376,400	1,202,200	169,000	15,447,400
2015	12,940,000	1,399,000	1,225,000	172,000	15,736,000
2016	12,616,800	1,368,200	1,194,600	167,800	15,347,400
2017	12,293,600	1,337,400	1,164,200	163,600	14,958,800
2018	11,970,400	1,306,600	1,133,800	159,400	14,570,200
2019	11,647,200	1,275,800	1,103,400	155,200	14,181,600
2020	11,324,000	1,245,000	1,073,000	151,000	13,793,000

Table A-7
Mining and Oil and Gas Employment by Location Under the Lower Production Scenario

Year	Campbell County	Other Counties	Total
2004	6,566	1,673	8,239
2005	7,062	1,906	8,968
2006	7,555	2,095	9,650
2007	7,657	2,128	9,785
2008	7,765	2,163	9,928
2009	7,717	2,117	9,834
2010	6,965	2,175	9,140
2011	7,171	2,318	9,489
2012	7,157	2,306	9,463
2013	7,116	2,296	9,412
2014	7,219	2,369	9,588
2015	7,157	2,458	9,615
2016	7,173	2,466	9,639
2017	7,192	2,477	9,669
2018	7,220	2,491	9,711
2019	7,254	2,507	9,761
2020	7,242	2,585	9,827

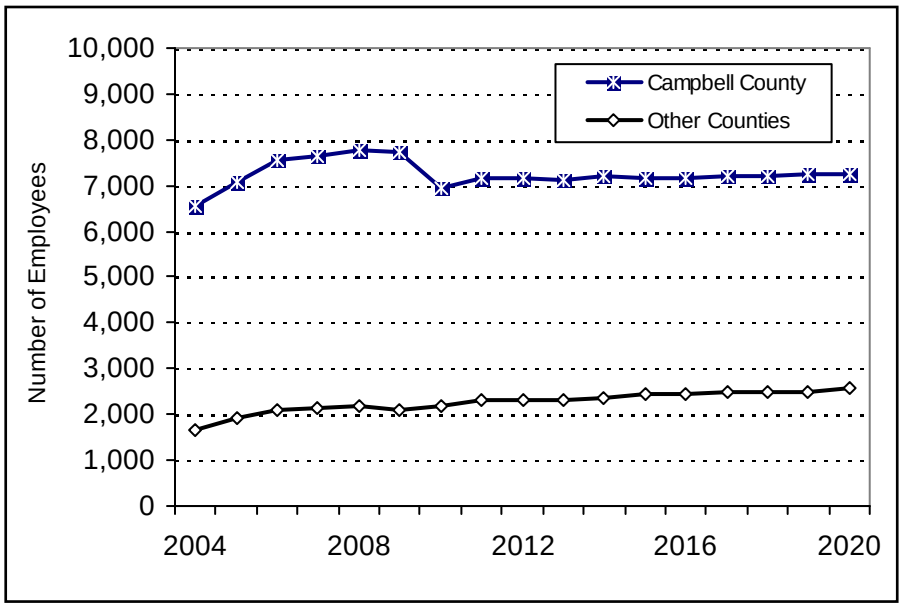


Figure A-4. Mining Sector Employment by Location Under the Lower Production Scenario

Table A-8
Mining and Oil and Gas Employment by Industrial Segment Under the Lower Production Scenario

Year	Coal Mining	Oil, Gas, and Other Mining	Total
2004	5,115	3,124	8,239
2005	5,209	3,759	8,968
2006	5,236	4,414	9,650
2007	5,262	4,523	9,785
2008	5,286	4,642	9,928
2009	5,312	4,522	9,834
2010	5,338	3,802	9,140
2011	5,372	4,117	9,489
2012	5,407	4,056	9,463
2013	5,440	3,972	9,412
2014	5,474	4,114	9,588
2015	5,508	4,107	9,615
2016	5,538	4,101	9,639
2017	5,567	4,102	9,669
2018	5,597	4,114	9,711
2019	5,627	4,134	9,761
2020	5,657	4,170	9,827

Note: Data include coal mine-related employment from the Task 2 database (for reporting years 2010, 2015, and 2020), plus allowances for other mining and oil and gas sectors as developed for the socioeconomics analysis. Between reporting years, data was determined through linear interpolation.

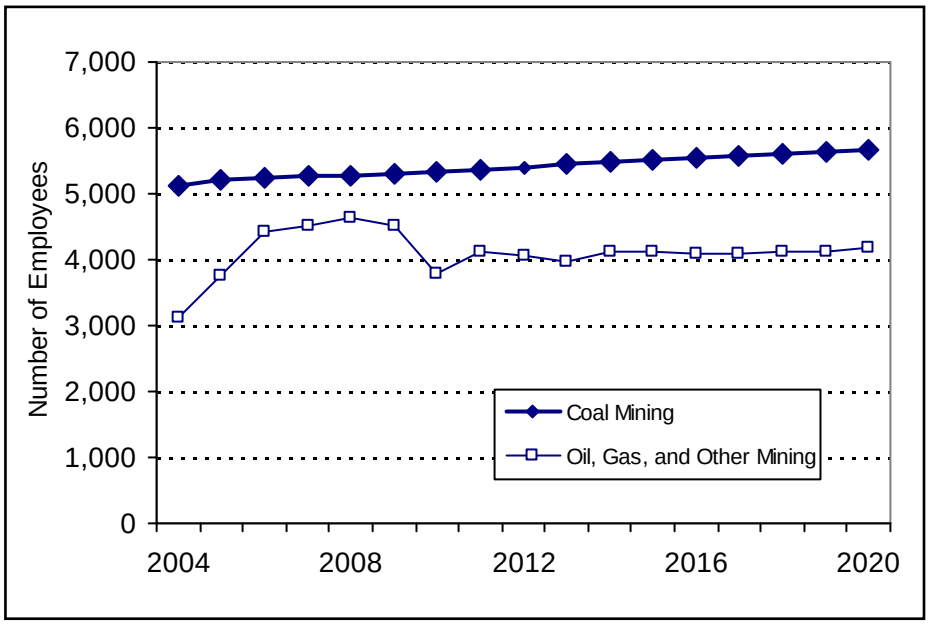


Figure A-5. Mining and Oil and Gas Employment by Industry Under the Lower Production Scenario

Table A-9
Mining and Oil and Gas Employment, Upper Versus Lower Production Scenario

Year	Upper Production Scenario	Lower Production Scenario	Differences
2004	8,462	8,239	223
2005	9,415	8,968	447
2006	10,183	9,650	533
2007	10,405	9,785	620
2008	10,637	9,928	709
2009	10,630	9,834	796
2010	10,150	9,140	1010
2011	10,375	9,489	886
2012	10,351	9,463	888
2013	10,304	9,412	892
2014	10,482	9,588	894
2015	10,512	9,615	897
2016	10,541	9,639	902
2017	10,578	9,669	909
2018	10,625	9,711	914
2019	10,680	9,761	919
2020	10,752	9,827	925

Projections of future tax revenues directly associated with mineral development were based on the overall value of production. The production values were, in turn, based on projected production and long-term prices. The prices used in this analysis were taken from the Wyoming CREG's January 2005 publication and are summarized in **Table A-10**.

Table A-10
Pricing Assumptions For Energy Resources

	2005	2006	2007 to 2020
Coal (per ton)	$6.95	$7.02	1% annual increase (nominal dollars)
Oil (per barrel)	$33.00	$35.00	$35.00
Natural Gas (per Mcf)	$4.75	$4.25	$4.25

Source: CREG 2005.
Note: Mcf = thousand cubic feet.

Semi-annually, CREG produces projections of major state government revenue streams for the upcoming 5 years, considering anticipated levels of mineral production, valuation, earnings on investments, and general fund sources of revenue (e.g., sales tax receipts). The projections help guide state budgeting. The projections generally are released in January and October and are available at http://eadiv.state.wy.us/CREG/CREG.asp. Information in CREG's January 2005 report was used in this analysis. The October 2005 report assumes higher energy resource prices, which, had they been incorporated into this report, would have resulted in proportional increases in the projected revenues presented in this report.

Ad valorem taxes were based on the most recent property tax mill levies of the affected counties and school districts. Those mill levies are presented in **Table A-11**.

Table A-11
Total 2004 Property Tax Levies for Selected PRB Counties and Affected School Districts

Taxing Entity	Total Mills
Counties	
Campbell	14.418
Converse	12.178
Johnson	18.542
Sheridan	14.000
School Districts	
Campbell #1	43.500
Converse #1	43.500
Converse #2	43.500
Johnson #1	47.500
Sheridan #1	45.720
Sheridan #2	43.000

Source: WTA 2005.

A.2 DESCRIPTION OF SOCIOECONOMIC MODELING METHODOLOGY

The principal socioeconomic impact analysis tool used for the PRB Coal Review was the REMI regional economic and demographic forecasting model. Steps were taken to configure and calibrate the default REMI forecast to baseline conditions in PRB. This step was necessary, because the default REMI forecast is predicated on historical trends and national economic forecasts that may not reflect any specific localized knowledge.

Calibrating the model was accomplished by analyzing local data and comparing it to information in the RFD scenarios. A set of inputs to the model was quantified and entered into the model. Once the model runs were completed, further analysis was needed to derive additional geographic detail in employment and population and to forecast future housing.

The version of the REMI model implemented for this analysis contained two economic regions. Region 1 consisted of a single county, Campbell County. Region 2, also called the surrounding counties region, consisted of Converse, Crook, Johnson, Natrona, Niobrara, Sheridan, and Weston counties. Counties included in the second region were selected because they adjoin or nearly adjoin Campbell County and are linked to the PRB by trade and commuting patterns. The nature of the trade and commuting patterns and the analysis of those patterns were presented in the Task 1C Report for the PRB Coal Review, Current Social and Economic Conditions (ENSR 2005a).

The last year of historical data in the REMI model available for the PRB Coal Review was 2002. The delivered model contains a default or “control” forecast that reflects a continuation of recent local economic trends modified to reflect projected changes in national economic conditions. The control forecast provided in REMI subsequently was recalibrated to reflect economic information available since 2002. REMI uses the “control” forecast as the basis for deriving differences (i.e., the impacts associated with alternative sets of assumed economic shocks entered into the model). The adjustments were based on available data and combined with the estimated economic values derived to represent the RFD scenarios. The combined values then were entered into the model. By using this approach, two processes (that of calibrating the model and that of inputting economic changes to cause the model to simulate a baseline RFD scenario) were accomplished in a single step. The rationale for the single step approach to calibration and baseline forecasting, as well as how the economic inputs to the model were developed, is discussed below.

A.2.1 RFD Scenarios and the REMI Control Forecast

The socioeconomic assessment drew directly on the Task 2 report and database. What emerged from Task 2 were two scenarios, termed the “lower” and “upper” production scenarios. An important step in the socioeconomic analysis was to translate the scenarios defined in Task 2 into economic terms that could be input into REMI.

The key data from Task 2 for the RFD scenarios are summarized in the following tables. **Table A-12** presents the RFD projections in terms of the numbers of mines, wells, power plants, etc., through the year 2020. **Table A-13** presents the development projections in terms of the volumes of commodities produced.

Table A-12
Summary of Wyoming PRB RFD Assumptions

Industry	2003 Existing	2003-2010	2011-2015	2016-2020	Total Increase
Active Coal Mines					
Lower Scenario	12[1]	+2[2]	0	0	+2[2]
Upper Scenario	12[1]	+2[2]	0	0	+2[2]
Conventional Oil and Gas Wells	18,302[3]	+5,194	+2,379	+1,946	+9,519
CBNG Wells	17,515[1]	+23,999	+18,809	+20,060	+62,868
Coal-fired Power Plants	6[4]	+3	0	+1 (upper scenario only)	+3 (lower scenario) +4 (upper scenario
Operating Railroads	2	0	+1	0	+1

[1]Reflects active coal mines only.
[2]Includes one temporarily inactive mine (as of 2003), which is projected to reinitiate operations, and one projected new mine near Sheridan.
[3]Estimated total number of wells drilled including producing, inactive, and plugged and abandoned.
[4]Excludes the Dave Johnston Power Plant, which is located outside the study area near Glenrock.
Source: ENSR 2005b.

Table A-13
Summary of Wyoming PRB RFD Production Assumptions

Industry	2003 Existing	2010	2015	2020	Total Change
Annual Coal Production					
Lower Scenario (mmtpy)	363.4	416.0	476.0	508.0	+ 144.6
Upper Scenario (mmtpy)	363.4	484.0	553.0	591.0	+ 227.6
Conventional Oil (barrels per year)	12,979,659	15,736,000	14,292,000	13,793,000	+ 813,341
Conventional Gas (mmcfpy)	39,981	42,750	38,910	35,100	- 4,891
CBNG (mmcfpy)	338,300	773,800	836,200	900,400	+ 562,100
Electrical Generation (MW of capacity)	702[1]	+1,000	0	+700 (upper scenario only)	+1,700
Railroad Coal-hauling Capacity (mmtpy)	350	400	440	500	+150

[1]Excludes the Dave Johnston Power Plant which is located outside the study area near Glenrock.
Source: ENSR 2005b.
Note: mmcfpy = million cubic feet per year
MW = megawatts

The decision to simultaneously calibrate the model to establish the revised baseline or "control" projection, as described above, was based on an understanding of how Task 2 assessed the prospects for energy development in the PRB. The key consideration was that Task 2 is at least implicitly predicated on three premises:

- The extension of past trends suggests a future for the PRB economy that could resemble the lower production scenario and its local economic effects.

- Additional coal production and other energy activities are a definite possibility (i.e., the upper production scenario could occur, albeit requiring advances in mining technology and substantial capital investments by the operators).

- Lower levels of energy and mineral resource activity than those assumed in the two scenarios are possible; however, the levels of development in the two RFD scenarios provide decision-makers and local communities with a form of potential "maximum impact" outlook on long-term economic and social conditions, based on information available through the end of 2004.

To implement this understanding, a decision was made to calibrate the REMI model to reflect the development assumptions of the lower coal production scenario. This would, in effect, establish the result as the baseline forecast for the study. The development assumptions of the upper production scenario then were entered into the REMI model as a separate simulation run consisting of just the incremental development that could occur. The development of inputs to represent the two "runs" is described below.

A.2.2 REMI Lower Production Scenario Inputs

Briefly summarized, the RFD lower production scenario for the socioeconomic analysis assumed the following:

- Coal production would increase to 508 mmtpy in 2020;

- Startup of two coal mines (one new and one currently idle);

- Coal mine labor productivity would increase;

- Development of 9,653 additional conventional oil and gas wells and 62,868 additional CBNG wells between 2004 and 2020;

- New capacity at the BNSF and UP railroads and the initial construction and start-up of the new DM&E line; and

- Three new power plants would begin operations by 2010.

The lower scenario's development assumptions were converted to the amounts of required direct employment (in jobs) and, as needed, additional output delivered (in dollars of sales of commodities) to

represent the new economic stimulus represented by the scenario. These values were compared to the employment and output assumptions implicit in the default forecast delivered with the REMI model. Adjustments then were made to other variables embedded in REMI to raise or lower the defaults to RFD scenario levels. The REMI default forecast then was re-run and the new results saved as the new control forecast, or baseline, for the analysis.

A.2.3 REMI Upper Production Scenario Inputs

For comparison to the above, the RFD upper production scenario for the socioeconomic analysis assumed the following:

- Coal production would increase to 591 mmtpy in 2020;
- Startup of two coal mines (one new and one currently idle);
- Coal mine labor productivity would increase, but at the same rate as under the lower production scenario;
- Cumulative oil and gas development would be equivalent to that under the lower production scenario;
- New capacity at the BNSF and UP railroads, with the construction and startup of the DM&E railroad in the “out years” of the forecast period; and
- Three new power plants would begin operations by 2010 and a fourth would begin operation by 2020.

The upper scenario’s development assumptions were converted to the amounts of direct employment required (in jobs) and, as needed, additional direct output delivered (in dollars of sales of commodities) to represent the additional economic stimulus generated by the upper scenario. These values were entered into REMI, which was then re-run and the new results used as the simulation of the upper production scenario.

A.2.4 Geographic Detail for Region 2 Employment

Employment estimates for the separate counties of REMI Region 2, the surrounding counties region, were made in the following steps. These were conducted in a separate “spreadsheet” model that used REMI forecasts and State of Wyoming data as inputs:

- A forecast of employment by industry by county was obtained from the State of Wyoming Economic Analysis Division (EAD)[1];
- EAD data were presented in terms of 15 NAICS sectors, so REMI employment data were “rolled up” to match;

[1] “Employment by Industry Forecast to 2020”. Unpublished electronic file dated February 2005. Available from the Wyoming Department of Administration and Information, EAD.

- The EAD forecast was sorted by industry, and county shares of each industry were calculated from the EAD forecast data;

- Projected shares for 2010, 2015, and 2020 were used to allocate the REMI control totals.

- Initial results were compared to employment data assumptions from the PRB scenarios and to the disaggregated population projections, and small ad hoc adjustments were made to the results for both PRB scenarios to smooth the transition from the last year of historical data in 2003 and to assure overall consistency with observed relationships between employment and population; and

- Ad hoc adjustments also were made to the results for the upper production scenario to adjust employment in the transportation industry for consistency with employment assumptions in the PRB scenario.

A.2.5 Geographic Detail for Region 2 Population

Age-specific population estimates for the separate counties of REMI Region 2 were made as follows, using a separate spreadsheet model, REMI forecasts, and State of Wyoming data:

- Historical data on population by age by county were obtained from the U.S. Census Bureau and Wyoming EAD[2];

- The Wyoming EAD data were sorted into 5 age groups, and shares were calculated for historical years from 1990 through 2003;

- The historical trend in the shares of each age group within each county was projected from the historical data to the forecast years of 2010, 2015, and 2020 using an exponential growth model (Excel "GROWTH" function);

- The shares projected for each year were normalized to add up to 100 percent within each county;

- The REMI projection of Region 2 population by age was assembled as the control total for the detailed projections;

- Projected shares were used to allocate the REMI control totals;

- Initial results were compared to employment data assumptions and to the disaggregated employment projections (described above); and

- Small ad hoc adjustments were made to the results for both PRB scenarios to selected counties for consistency with employment assumptions in the PRB scenario.

[2] "Annual Population for Counties, Cities, and Towns: 1990-2000" and "Estimates of City and Town Population: July 1, 2004". Available online at http://eadiv.state.wy.us/pop/pop.asp.

Total population estimates also were projected for selected communities within the counties of REMI Region 2. These were made as follows, again using a separate spreadsheet model, REMI forecasts, and standard historical data:

- Data were obtained from the Wyoming EAD and the U.S. Census Bureau on population of incorporated places by county[3];
- The shares of selected communities and the balance of county population in each county were projected from historical data from 2000 through 2004 using the Excel "GROWTH" function;
- The shares projected for each year were pro rated to add up to 100 percent within each county;
- The REMI projection of Region 2 population by county was assembled from the previous disaggregation model to use as the control total for the detailed projections;
- Projected shares were used to allocate the REMI control totals; and
- Initial results were compared to employment data assumptions in the PRB scenarios, and small ad hoc adjustments were made in selected communities for consistency with those assumptions.

A.2.6 Detailed Housing Demand

The procedure used to forecast total housing requirements in the future reflected projections of the long-term trend toward smaller household sizes:

- Data on household formation and vacancy for each county in the PRB study area were obtained from historical U.S. censuses;
- Population-to-household ratios were projected forward to 2005, 2010, and 2015 using the Excel "GROWTH" function fitted to decennial data from 1940 to 2000;
- Small ad hoc adjustments were made in Campbell, Sheridan, and Johnson counties to lower household formation rates and housing requirements from trend-projected levels to reflect the demographic impact of younger economic migrants drawn by job opportunities in the PRB;
- The REMI projection of Region 2 population by county was assembled from the previous disaggregation model to use as the control total for the detailed projections;
- Preliminary estimates of household were derived by dividing county population by the projected population-to-household ratios; and

[3] "Annual Population for Counties, Cities, and Towns: 1990-2000" and "Estimates of City and Town Population: July 1, 2004". Available online at http://eadiv.state.wy.us/pop/pop.asp.

- Two final adjustments were applied based on historical data to reach the final forecast of housing units: a 3.5 percent housing vacancy allowance and a fixed amount for an assumed standing pool of seasonal units.

A.3 REMI RESULTS

The results of a REMI run are estimated outcomes for many different economic variables that could occur under the given scenarios. The PRB Coal Review used four of these variables in particular to develop the information presented in this Task 3C report:

- Employment (in terms of jobs), disaggregated by North American Industrial Classification System (NAICS) sector;
- Population, by key age groups;
- Work force commuting, with estimated numbers of employed persons that commute in and out of each model region; and
- Net migration for each model region.

The REMI model produced an estimate of each variable and its subcategories for the two model regions, Campbell County (Region 1) and the surrounding counties (Region 2). In the case of Region 2, the REMI model produced one lump-sum estimate of each variable and category to represent the region as a whole. The method used to expand the lump-sum Region 2 estimates into separate estimates for each county and for selected communities in Region 2 is described below.

A.3.1 Total Projected Employment

Simulations for the PRB Coal Review were conducted with REMI[4], a regional economic impact forecasting model. Resource policy and engineering assumptions presented in the RFD scenarios were interpreted and expressed in terms of the economic-policy categories available in REMI. **Tables A-14** through **A-18** present the projected employment, by major industrial sector, resulting from the anticipated economic stimuli in the study area, as defined by the lower and upper production scenarios.

For this study, employment by industry for Campbell County was taken directly from the REMI model. Totals by REMI's 24 industries were grouped to match the 15-industry data from the State of Wyoming. These results are presented in **Tables A-14** and **A-15**. All industry categories are based on NAICS.

[4] REMI Policy Insight is a product of Regional Economic Models, Inc. 306 Lincoln Ave., Amherst, Massachusetts, 01002.

Table A-14
REMI Results for Employment by Industry in Campbell County Under the Lower Production Scenario
(thousands)

15-Sector Summary	2005	2010	2015	2020
Natural Resources and Mining	7.229	7.133	7.331	7.436
Utilities	0.225	0.402	0.368	0.319
Construction	3.266	3.510	3.661	3.763
Manufacturing	0.457	0.493	0.513	0.473
Wholesale Trade	1.153	1.154	1.116	1.052
Retail Trade	2.721	2.879	2.891	2.816
Transportation and Warehousing	1.007	1.030	1.118	1.148
Information	0.211	0.233	0.245	0.248
Financial Activities	1.118	1.115	1.136	1.147
Professional and Business Services	2.248	2.463	2.654	2.755
Education and Health Services	1.255	1.508	1.765	2.036
Leisure and Hospitality	2.184	2.366	2.472	2.461
Other Services (excluding government)	1.324	1.388	1.418	1.400
Government	3.845	4.496	4.777	4.841
Farm	0.600	0.567	0.527	0.479
Total Employment	**28.843**	**30.737**	**31.992**	**32.374**

Table A-15
REMI Results for Employment by Industry in Campbell County Under the Upper Production Scenario
(thousands)

15-Sector Summary	2005	2010	2015	2020
Natural Resources and Mining	7.676	8.126	8.210	8.359
Utilities	0.234	0.452	0.402	0.467
Construction	3.376	3.845	3.946	4.111
Manufacturing	0.459	0.527	0.536	0.476
Wholesale Trade	1.184	1.220	1.173	1.108
Retail Trade	2.823	3.126	3.110	3.055
Transportation and Warehousing	1.014	1.046	1.132	1.168
Information	0.214	0.241	0.253	0.257
Financial Activities	1.170	1.208	1.217	1.234
Professional and Business Services	2.354	2.694	2.881	3.023
Education and Health Services	1.273	1.568	1.838	2.144
Leisure and and Hospitality	2.263	2.545	2.629	2.639
Other Services (excluding government)	1.367	1.487	1.502	1.493
Government	3.873	4.664	5.030	5.193
Farm	0.600	0.567	0.527	0.479
Total Employment	**29.880**	**33.316**	**34.386**	**35.206**

Total REMI employment by industry for Region 2 was consolidated from 24 industries to the 15 industries in the data from the State of Wyoming. These results are presented in **Tables A-16** and **A-17**.

Table A-16
REMI Results for Employment by Industry in Region 2 Under the Lower Production Scenario
(thousands)

15-Sector Summary	2005	2010	2015	2020
Natural Resources and Mining	6.611	6.402	6.374	6.219
Utilities	0.377	0.364	0.356	0.346
Construction	7.641	7.740	8.215	8.553
Manufacturing	2.475	2.433	2.455	2.465
Wholesale Trade	3.335	3.305	3.156	2.976
Retail Trade	11.093	11.553	11.405	10.947
Transportation and Warehousing	2.576	2.546	2.546	2.537
Information	1.065	1.144	1.187	1.202
Financial Activities	7.312	7.698	7.975	8.055
Professional and Business Services	8.041	8.624	9.145	9.501
Education and Health Services	9.689	11.014	12.493	14.098
Leisure and Hospitality	8.720	9.336	9.550	9.370
Other Services (excluding government)	5.210	5.508	5.602	5.497
Government	12.997	13.584	14.020	14.048
Farm	3.315	3.131	2.914	2.645
Total Employment	**90.457**	**94.382**	**97.393**	**98.459**

Note: Region 2 consists of Converse, Crook, Johnson, Natrona, Niobrara, Sheridan, and Weston counties. For this analysis, the totals were adjusted to net out employment in Natrona and Niobrara counties.

Table A-17
REMI Results for Employment by Industry in Region 2 Under the Upper Production Scenario (thousands)

15-Sector Summary	2005	2010	2015	2020
Natural Resources and Mining	6.651	6.488	6.457	6.301
Utilities	0.378	0.366	0.358	0.347
Construction	7.672	7.834	8.308	8.644
Manufacturing	2.477	2.436	2.458	2.468
Wholesale Trade	3.34	3.316	3.167	2.986
Retail Trade	11.128	11.638	11.487	11.033
Transportation and Warehousing	2.578	2.549	2.549	2.541
Information	1.066	1.147	1.191	1.205
Financial Activities	7.333	7.744	8.019	8.101
Professional and Business Services	8.065	8.68	9.203	9.564
Education and Health Services	9.699	11.04	12.525	14.147
Leisure and Hospitality	8.751	9.404	9.612	9.435
Other Services (excluding government)	5.226	5.548	5.639	5.535
Government	13.005	13.635	14.1	14.147
Farm	3.315	3.131	2.914	2.645
Total Employment	**90.684**	**94.956**	**97.987**	**99.099**

Note: Region 2 consists of Converse, Crook, Johnson, Natrona, Niobrara, Sheridan, and Weston counties. For this analysis, the totals were adjusted to net out employment in Natrona and Niobrara counties.

Employment by industry for each county in Region 2 was estimated in a separate “spreadsheet” model. A forecast of employment by industry from the State of Wyoming EAD provided the initial basis for the disaggregation. Those results were compared to employment data assumptions from the PRB scenarios and Bureau of Economics and Wyoming Labor Market Information System data and to the disaggregated population projections. Small ad hoc adjustments were made to the results for the PRB scenarios to establish consistency between employment and population and to adjust transportation employment for consistency with assumptions in the PRB scenario. The adjusted, projected shares for 2010, 2015, and 2020 were used to allocate REMI industry control totals. **Table A-18** presents these allocation assumptions.

Table A-18
Disaggregation Assumptions for Employment by Industry in the Surrounding Counties

Industry/Location	2005	2010	2015	2020
Natural Resources and Mining				
Converse County	12.2%	12.0%	11.8%	11.6%
Crook County	5.8%	5.6%	5.4%	5.2%
Johnson County	7.2%	8.0%	8.8%	9.6%
Sheridan County	9.3%	9.5%	10.0%	10.2%
Weston County	8.7%	8.4%	8.1%	7.9%
Natrona and Niobrara	56.8%	56.5%	55.9%	55.5%
Utilities				
Converse County	30.9%	31.1%	31.3%	31.5%
Crook County	2.5%	2.6%	2.6%	2.6%
Johnson County	1.6%	1.8%	2.2%	2.2%
Sheridan County	33.2%	32.9%	32.5%	32.3%
Weston County	5.3%	5.3%	5.3%	5.3%
Natrona and Niobrara	26.4%	26.3%	26.1%	26.1%
Construction				
Converse County	8.8%	8.8%	8.8%	8.8%
Crook County	4.9%	4.8%	4.8%	4.8%
Johnson County	4.4%	4.5%	4.7%	4.8%
Sheridan County	22.5%	22.6%	22.7%	22.8%
Weston County	4.0%	4.0%	4.0%	4.0%
Natrona and Niobrara	55.3%	55.2%	55.0%	54.8%
Manufacturing				
Converse County	15.3%	17.9%	19.4%	20.4%
Crook County	4.6%	4.4%	4.4%	4.4%
Johnson County	0.6%	0.8%	1.0%	1.2%
Sheridan County	14.3%	13.3%	12.6%	12.6%
Weston County	4.9%	4.5%	4.5%	4.5%
Natrona and Niobrara	60.3%	59.1%	58.1%	56.9%
Wholesale Trade				
Converse County	2.2%	2.4%	2.6%	2.8%
Crook County	1.0%	0.9%	0.8%	0.7%
Johnson County	3.8%	4.0%	4.2%	4.3%
Sheridan County	11.6%	11.3%	11.0%	10.8%
Weston County	1.0%	1.0%	1.0%	1.0%
Natrona and Niobrara	80.4%	80.4%	80.4%	80.4%
Retail Trade				
Converse County	6.7%	6.5%	6.3%	6.1%
Crook County	3.0%	3.2%	3.2%	3.2%
Johnson County	5.5%	5.8%	6.1%	6.4%
Sheridan County	21.0%	21.8%	22.1%	22.7%
Weston County	4.5%	4.5%	4.5%	4.5%
Natrona and Niobrara	59.3%	58.2%	57.8%	57.1%
Transportation and Warehousing				
Converse County	6.5%	6.1%	5.9%	5.7%
Crook County	12.0%	11.5%	11.0%	10.6%
Johnson County	3.5%	3.6%	3.7%	3.8%
Sheridan County	21.1%	22.3%	23.5%	24.7%
Weston County	14.0%	14.0%	14.0%	14.0%
Natrona and Niobrara	43.0%	42.4%	41.9%	41.2%
Information				
Converse County	7.3%	6.8%	6.3%	5.8%
Crook County	1.5%	1.3%	1.1%	0.9%
Johnson County	5.5%	5.5%	5.5%	5.5%
Sheridan County	19.5%	22.4%	24.8%	26.0%
Weston County	3.9%	3.5%	3.1%	2.7%
Natrona and Niobrara	62.3%	60.5%	59.2%	59.1%

Table A-18 (continued)

Industry/Location	2005	2010	2015	2020
Financial Activities				
Converse County	5.4%	5.6%	5.8%	6.0%
Crook County	2.0%	2.0%	2.0%	2.0%
Johnson County	5.0%	5.2%	5.3%	5.5%
Sheridan County	21.7%	22.0%	22.8%	23.8%
Weston County	2.7%	2.8%	2.9%	3.1%
Natrona and Niobrara	63.1%	62.4%	61.2%	59.6%
Professional and Business Services				
Converse County	4.0%	4.0%	4.1%	4.1%
Crook County	1.3%	1.4%	1.5%	1.6%
Johnson County	2.2%	3.0%	3.5%	4.0%
Sheridan County	17.9%	18.2%	18.6%	18.9%
Weston County	5.0%	5.0%	5.0%	5.0%
Natrona and Niobrara	69.5%	68.4%	67.3%	66.4%
Education and Health Services				
Converse County	4.4%	4.3%	4.1%	4.1%
Crook County	1.0%	0.9%	0.8%	0.8%
Johnson County	2.7%	2.8%	2.9%	3.0%
Sheridan County	25.0%	23.8%	22.3%	21.5%
Weston County	3.3%	3.2%	3.0%	3.0%
Natrona and Niobrara	63.6%	65.0%	66.8%	67.6%
Leisure and Hospitality				
Converse County	8.3%	8.1%	8.1%	8.3%
Crook County	4.3%	4.7%	4.7%	4.6%
Johnson County	7.5%	7.7%	7.8%	7.9%
Sheridan County	23.6%	23.7%	23.8%	23.9%
Weston County	3.9%	3.9%	3.9%	3.9%
Natrona and Niobrara	52.4%	51.9%	51.7%	51.4%
Other Services				
Converse County	3.9%	3.9%	4.0%	4.0%
Crook County	1.8%	1.6%	1.5%	1.4%
Johnson County	5.6%	5.8%	5.9%	5.9%
Sheridan County	22.5%	23.7%	24.8%	25.5%
Weston County	5.0%	4.8%	4.6%	4.4%
Natrona and Niobrara	61.2%	60.1%	59.2%	58.8%
Government				
Converse County	10.8%	10.7%	10.6%	10.5%
Crook County	5.3%	5.3%	5.3%	5.3%
Johnson County	7.2%	7.3%	7.4%	7.4%
Sheridan County	24.0%	23.6%	23.2%	22.7%
Weston County	5.8%	5.8%	5.8%	5.8%
Natrona and Niobrara	46.8%	47.4%	47.7%	48.3%
Farm				
Converse County	13.3%	13.3%	13.2%	13.1%
Crook County	18.2%	18.5%	18.9%	19.2%
Johnson County	13.6%	13.4%	13.3%	13.2%
Sheridan County	22.9%	22.8%	22.8%	22.8%
Weston County	9.0%	9.1%	9.2%	9.2%
Natrona and Niobrara	23.1%	22.9%	22.7%	22.5%

Note: Region 2 consists of Converse, Crook, Johnson, Natrona, Niobrara, Sheridan, and Weston counties. For this analysis, the totals were adjusted to net out employment in Natrona and Niobrara counties.

A.3.2 Detailed Demographic Projections

For this study, population by age for Campbell County was taken directly from the REMI model. These results are presented in **Tables A-19** and **A-20**.

Table A-19
Population by Age for Campbell County Under the Lower Production Scenario
(000s)

Age Group	2005	2010	2015	2020
<5	2.837	3.602	3.684	3.431
5-18	8.155	8.542	9.108	9.71
19-24	4.120	3.567	3.028	2.88
25-64	22.189	27.156	28.469	28.221
65+	2.199	3.058	4.616	6.753
Total	**39.500**	**45.925**	**48.905**	**50.995**

Table A-20
Population by Age for Campbell County Under the Upper Production Scenario
(000s)

Age Group	2005	2010	2015	2020
<5	2.870	3.816	3.984	3.806
5-18	8.210	8.901	9.713	10.622
19-24	4.172	3.781	3.239	3.183
25-64	22.357	28.207	30.069	30.454
65+	2.200	3.077	4.679	6.878
Total	**39.809**	**47.782**	**51.684**	**54.943**

Population by age in each county of the surrounding counties region was estimated in a separate "spreadsheet" model, beginning with total REMI population by age for the region as a whole. The regional population data are presented in **Tables A-21** and **A-22**.

Table A-21
Population by Age for the Surrounding Counties Under the Lower Production Scenario
(000s)

Age Group	2005	2010	2015	2020
<5	7.842	8.870	9.472	9.390
5-18	23.650	22.320	23.146	25.180
19-24	12.300	10.689	9.374	8.666
25-64	68.582	73.162	74.595	73.558
65+	18.669	20.645	24.055	28.540
Total	**131.043**	**135.686**	**140.642**	**145.334**

Table A-22
Population by Age for the Surrounding Counties Under the Upper Production Scenario
(000s)

Age Group	2005	2010	2015	2020
<5	7.853	8.936	9.571	9.502
5-18	23.669	22.435	23.347	25.464
19-24	12.319	10.757	9.448	8.758
25-64	68.641	73.49	75.135	74.254
65+	18.671	20.652	24.075	28.579
Total	**131.153**	**136.270**	**141.576**	**146.557**

A forecast of population by age from the State of Wyoming EAD provided the initial basis for developing age group shares for each county. Initial results were compared to employment data assumptions from the PRB scenarios and to the disaggregated employment projections. Small ad hoc adjustments were made to the results for both PRB scenarios for consistency between employment and population. The adjusted, projected shares for 2010, 2015, and 2020 were used to allocate REMI industry control totals. **Table A-23** presents these allocation assumptions.

Table A-23
Disaggregation Assumptions for Population by Age in the Surrounding Counties

County/Age	2005	2010	2015	2020
Converse				
<5	9.4%	9.1%	8.9%	8.7%
5-18	10.3%	10.2%	10.1%	10.0%
19-24	7.5%	7.6%	7.4%	6.9%
25-64	9.9%	10.2%	10.3%	10.3%
65+	8.1%	8.5%	8.9%	9.3%
Crook				
<5	3.3%	3.3%	2.8%	2.4%
5-18	4.9%	5.3%	5.1%	4.9%
19-24	3.5%	3.7%	3.6%	3.5%
25-64	4.7%	4.9%	4.9%	4.9%
65+	5.1%	5.3%	5.5%	5.7%
Johnson				
<5	4.6%	4.7%	4.7%	4.7%
5-18	5.5%	5.7%	6.0%	6.2%
19-24	3.7%	4.5%	4.1%	3.7%
25-64	5.9%	6.5%	6.7%	6.9%
65+	7.2%	7.1%	6.9%	6.8%
Sheridan				
<5	18.7%	19.2%	19.9%	20.4%
5-18	20.1%	20.3%	20.5%	20.7%
19-24	19.6%	20.1%	20.7%	21.4%
25-64	21.4%	21.7%	22.0%	22.4%
65+	22.9%	22.3%	21.6%	20.9%
Weston				
<5	4.3%	4.1%	3.8%	3.6%
5-18	4.7%	4.3%	4.0%	3.7%
19-24	4.2%	4.1%	4.0%	3.8%
25-64	5.1%	5.0%	4.9%	4.7%
65+	5.9%	5.9%	5.9%	5.9%

A.3.3 Projected Housing Requirements

Total housing requirement projections were driven by projections of total population per household ratios. Total population projections were divided by the ratios to estimate new households requiring housing. **Tables A-24** through **A-26** present the total population by county and the corresponding ratios. Small ad hoc adjustments were made in Campbell, Sheridan, and Johnson counties. The adjustments marginally raised the population-to-households ratio and lowered housing requirements from trend-projected levels to reflect the demographic impact of younger economic migrants drawn by job opportunities in the PRB.

Table A-24
Housing Requirements Assumptions Under the Lower Production Scenario

County	2003	2010	2015	2020
Campbell	13,707	18,015	19,260	20,177
Converse	5,741	6,004	6,314	6,621
Crook	3,036	3,277	3,438	3,615
Johnson	3,622	4,119	4,340	4,560
Sheridan	12,861	13,563	14,290	14,917
Weston	3,273	3,420	3,523	3,618
Six-County Study Area	**42,240**	**48,398**	**51,165**	**53,508**

Table A-25
Housing Requirements Assumptions Under the Upper Production Scenario

County	2003	2010	2015	2020
Campbell	13,707	18,674	20,273	21,694
Converse	5,741	6,026	6,358	6,677
Crook	3,036	3,289	3,459	3,642
Johnson	3,622	4,133	4,368	4,596
Sheridan	12,861	13,613	14,388	15,045
Weston	3,273	3,433	3,545	3,647
Six-County Study Area	**42,240**	**49,168**	**52,391**	**55,301**

Table A-26
Average Persons per Household for Estimated Housing Requirements

County	2005	2010	2015	2020
Campbell	2.74	2.73	2.71	2.69
Converse	2.53	2.50	2.46	2.42
Crook	2.49	2.43	2.37	2.31
Johnson	2.38	2.37	2.36	2.35
Sheridan	2.37	2.36	2.35	2.35
Weston	2.47	2.41	2.35	2.29