

Screening Model for ECBM Recovery and CO₂ Sequestration in Coal

Coal-Seq V1.0

Topical Report

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Executive Summary

In October 2000, the U.S. Department of Energy, through contractor Advanced Resources International (ARI), launched a three-year government-industry R&D collaboration called the Coal-Seq project. The Coal-Seq project is investigating the feasibility of CO₂ sequestration in deep, unmineable coalseams, by performing detailed reservoir studies of two enhanced coalbed methane recovery (ECBM) field projects in the San Juan basin. The two sites are the Allison Unit, operated by Burlington Resources, and into which CO₂ is being injected, and the Tiffany Unit, operated by BP America, into which N₂ is being injected (the interest in understanding the N₂-ECBM process has important implications for CO₂ sequestration via flue-gas injection). The purposes of the field studies are to understand the reservoir mechanisms of CO₂ and N₂ injection into coalseams, demonstrate the practical effectiveness of the ECBM and sequestration processes, demonstrate an engineering capability to model them, and to evaluate sequestration economics. In support of these efforts, laboratory and theoretical studies are also being performed to understand and model multi-component isotherm behavior, and coal permeability changes due to swelling with CO₂ injection. To facilitate industry realization of the benefits of an improved knowledge of ECBM processes, a screening model has been developed.

The purposes of the model are to:

- Capture the technical findings of the Coal-Seq project in an easy-to-use tool that can predict the results of an ECBM/CO₂-sequestration project under a broad set of conditions and assumptions.
- Put that tool directly in the hands of industry to facilitate project consideration and screening.

The model consists of a database of reservoir simulation cases, which can be retrieved and compared. Results are presented both graphically and in tabular form, and include incremental methane recoveries and CO₂ sequestration volumes. Economic calculations can also be performed. An inherent assumption in the model is that an existing coalbed methane field is being converted to ECBM/carbon-sequestration service; the economics of a grass-roots project, which include the costs associated with production well drilling, are not considered.

ARI's COMET3 simulator was utilized to build the model. Starting with a base-case set of model parameters, the user can then select one of three values for seven different parameters, including permeability, well spacing, depth, coal rank, injection rate, injection gas, and injection timing. In addition, the user can specify any coal thickness.

In total, 1975 simulation runs were performed, out of a total of all possible combinations of 2268 (some runs could not be made due to incompatible reservoir/operating conditions, such as low permeability and high injection rates for example).

The database used is Microsoft Access, and the user interface to facilitate data retrieval and manipulation was built using Microsoft Visual Basic. Microsoft Access 2000 with the latest service packs is required to use the model.

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1.0 Introduction

In October 2000, the U.S. Department of Energy (DOE), through contractor Advanced Resources International (ARI), launched a three-year government-industry R&D collaboration called the Coal-Seq project¹. The Coal-Seq project is investigating the feasibility of CO₂ sequestration in deep, unmineable coalseams, by performing detailed reservoir studies of two enhanced coalbed methane recovery (ECBM) field projects in the San Juan basin. The two sites are the Allison Unit, operated by Burlington Resources, and into which CO₂ is being injected, and the Tiffany Unit, operated by BP America, into which N₂ is being injected (the interest in understanding the N₂-ECBM process has important implications for CO₂ sequestration via flue-gas injection). The purposes of the field studies are to understand the reservoir mechanisms of CO₂ and N₂ injection into coalseams, demonstrate the practical effectiveness of the ECBM and sequestration processes, demonstrate an engineering capability to model them, and to evaluate sequestration economics. In support of these efforts, laboratory and theoretical studies are also being performed to understand and model multi-component isotherm behavior, and coal permeability changes due to swelling with CO₂ injection. To facilitate industry realization of the benefits of an improved knowledge of ECBM processes resulting from this project, a screening model has been developed.

The purposes of the model are to:

- Capture the technical findings of the Coal-Seq project in an easy-to-use tool that can predict the results of an ECBM/CO₂-sequestration project under a broad set of conditions and assumptions.
- Put that tool directly in the hands of industry to facilitate project consideration and screening.

This report describes the model and also serves as the Users Manual for it.

2.0 Model Construction & Assumptions

2.1 Model Construction

The model consists of a database of reservoir simulation cases, which can be retrieved and compared. Results are presented both graphically and in tabular form, and include incremental methane recoveries and CO₂ sequestration volumes. Economic calculations can also be performed. An inherent assumption in the model is that an existing coalbed methane field is being converted to ECBM/carbon-sequestration service; the economics of a grass-roots project, which include the costs associated with production well drilling, are not considered.

ARI's COMET3 simulator was utilized to build the model. A technical description of the simulator can be found in the references². Starting with a base-case set of model parameters, the user can then select one of three values for seven different parameters, as follows:

- Permeability: 1 mD, 10 mD or 100 mD.
- Spacing: 40 acres, 160 acres or 640 acres.
- Depth: 1,000 ft, 5,000 ft or 10,000 ft.
- Coal Rank: high, medium or low.
- Injection Rate: 10 Mscfd/ft, 50 Mscfd/ft or 100 Mscfd/ft.
- Injection Gas: 100% CO₂, 100% N₂ or 50% CO₂ / 50% N₂.
- Injection Timing: the first 7.5 years, the second 7.5 years or continuous for 15 years.

In total, 1975 simulation runs were performed, out of a total of all possible combinations of 2268 (3⁷ runs plus a no-injection scenario for each case) the results of which are stored in the database of this application (some runs could not be made due to incompatible reservoir/operating conditions, such as low permeability and high injection rates for example). In addition, the user can specify any coal thickness; the results from the database (which were all run with a thickness of 10 feet), are automatically scaled up or down according to the input coal thickness.

The database used is Microsoft Access, and the user interface to facilitate data retrieval and manipulation was built using Microsoft Visual Basic. Microsoft Access 2000 with the latest service packs is required to use the model.

2.2 Constants and Assumptions

This section describes the constants and assumptions of the model. It should be noted that all the simulations were run for 15 years.

2.2.1 Initial Conditions

The initial conditions for each simulation were:

- Initial water saturation: $S_{wi} = 100\%$
- Reservoir pressure gradient: 0.43 psi/ft
- Reservoir temperature: $60^{\circ}\text{F} + 2^{\circ}/100\text{ ft}$

2.2.2 Geometry

The reservoir geometry was:

- Coals are flat lying.
- Coals are represented by a single layer.
- Any coal thickness can be selected; the model results are up scaled or downscaled accordingly.

2.2.3 Reservoir Properties

The reservoir properties were:

- Permeability anisotropy: 1:1
- Vertical permeability: $K_v = 0$
- Porosity: $\phi = 0.25\%$.
- Fracture spacing: $FS = 0.5\text{ inches}$.

2.2.4 Desorption Data

- The initial conditions are always saturated (equilibrium with isotherm) with respect to gas content (100% methane).
- The coal isotherms are shown on Figure 1.
- The Langmuir Volume and Langmuir Pressure constants used are summarized in Table 1. These data were obtained from the literature^{3,4,5}.
- Sorption time: $\tau = 10\text{ days}$ (all gases, all coals)
- Coal density basis: $\rho_{\text{coal}} = 1.8\text{ g/cc}$

Table 1: Langmuir Constants

Rank	Vro	Nitrogen		Methane		Carbon Dioxide	
		VL (scf/ton)	PL (psi)	VL (scf/ton)	PL (psi)	VL (scf/ton)	PL (psi)
Sub Bit	0.40	45	2125	45	1650	650	725
Hi Vol Bit	0.90	150	1600	250	845	650	300
Med Vol Bit	1.30-1.40	250	1400	450	560	650	240

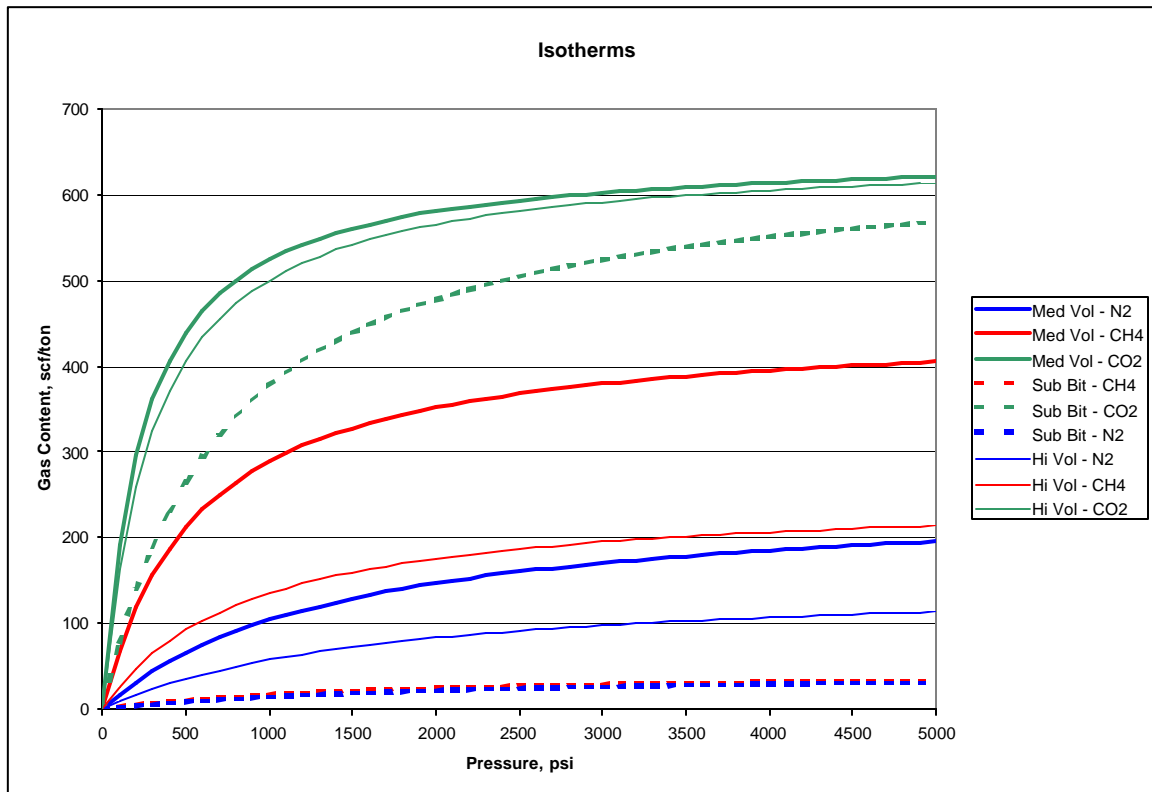


Figure 1: Isotherms

2.2.5 Gas PVT Data

The gas PVT data were:

- Gas gravity = 0.6
- In-situ gas composition: 100% methane
- Water specific gravity: 62.4 lbm/ft³
- Water viscosity: 0.577414 cp

Gas PVT properties were automatically derived via correlations in the COMET3 model.

2.2.6 Compressibilities

The formation compressibility assumptions were:

- Pore volume compressibility: $C_p = 200 \times 10^{-6} \text{ psi}^{-1}$
- Matrix shrinkage compressibility: $C_m = 1 \times 10^{-6} \text{ psi}^{-1}$
- Permeability exponent: $n = 0$

Note: Since $n=0$, no pressure-dependant permeability or matrix shrinkage/swelling was considered.

2.2.7 Relative Permeability and Capillary Pressure

The relative permeability and capillary pressure assumptions were:

- The relative permeability curves are shown on Figure 2.
- There is no capillary pressure function.

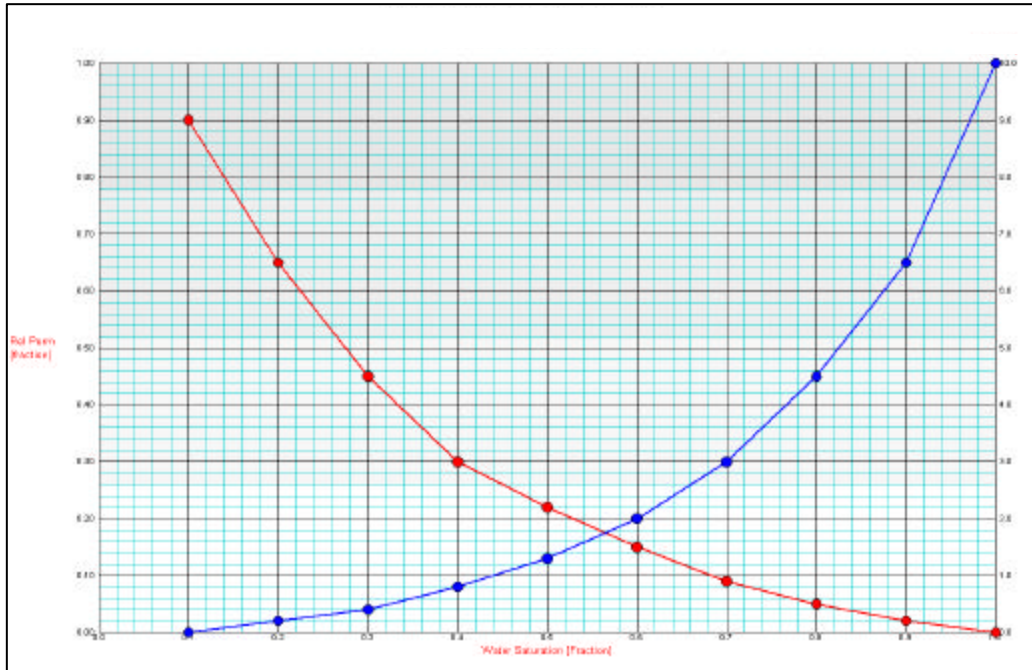


Figure 2: Relative Permeability Curves

2.2.8 Production / Injection Wells

The well control were:

- Flowing bottom hole pressure for the producing wells: FBHP = 50 psi.
- A flowing bottom hole pressure for injection wells was not considered (i.e., injection rates were specified with no constraints on pressure).
- Skin factor for producing wells: $s=-2$
- Skin factor for injection wells: $s=0$
- Wellbore radius: $r = 0.33$ feet (8'' hole)

3.0 Using the Model

3.1 Installation

The installation requires only a few steps.

- Create a folder on the C drive named **CoalSeq** (C:\CoalSeq).
- Copy the executable CoalSeq.exe as well as the folder Database and the manual (Manual.pdf), provided on the CD, in the CoalSeq folder newly created (C:\CoalSeq\CoalSeq.exe, C:\CoalSeq\Database and C:\CoalSeq\Manual.pdf).

The model is now ready to be used.

3.2 Running The Model

This section describes step by step how to use this model, specifically how to select the input data, make plots, export the data, run economic evaluations and print the results.

3.2.1 Plot Input

The user will define first the cases intended to be studied by selecting the simulation's parameters. As CoalSeq provides the user with a graphic picture of the results, some characteristics of the graphic will have to be determined. The user may input the following data (refer to Figure 3).

3.2.1.1 Cases' Selection

① Main Case

The main case can only be a non-injection case. Four parameters can be selected:

- Permeability: 1 mD, 10 mD or 100 mD.
- Spacing: 40 acres, 160 acres or 640 acres.
- Depth: 1,000 ft, 5,000 ft or 10,000 ft.
- Coal Rank: high, medium or low.

Once the above parameters have been selected, click the 'Get Data' button to import the corresponding data from the database, as well as each time any parameter is changed, as the database is not automatically updated.

② Comparison 1 / 2 / 3

Added to the main case, three other cases can be imported for comparison purposes. Seven parameters can be selected, the same four as for the main case as well as

- Injection Rate: 10 Mscfd/ft, 50 Mscfd/ft or 100 Mscfd/ft.
- Injection Gas: 100 % CO₂, 100 % N₂ or 50% CO₂ / 50% N₂.

- Injection Timing: the first 7.5 years, the second 7.5 years or continuous for 15 years.

The same remark as for the main case applies to import the data.

③ Coal Thickness

All the simulations have been run using a 10 feet coal thickness. Adjustments to thickness are done on a simple ratio.

3.2.1.2 Plot's Characteristics

④ Plot Title:

Two lines are available to give a title to the plot. The title will be visible at the top of the plot on the *Chart* tab as well as on the printout.

⑤ X Axis

Fourteen different parameters can be selected from the dropdown list for the X-axis. They are the following:

- Time
- CH₄ Production Rate
- Cumulative Produced CH₄
- CO₂ Production Rate
- Cumulative Produced CO₂
- N₂ Production Rate
- Cumulative Produced N₂
- Total Gas Rate
- CO₂ Injection Rate
- Cumulative Injected CO₂
- N₂ Injection Rate
- Cumulative Injected N₂
- % N₂/CO₂
- Net CO₂ Sequestration.

The user has the option to make some modifications to the minimum, maximum and major step of the scale (the major step indicates where the gridlines will be positioned).

⑥ Y Axis

The same parameters are available for the Y-axis as for the X-axis. The first time the plot is drawn, the maximum value for the Y-axis is computed as being the maximum value of the selected parameter of the imported cases. The major step is computed as the tenth of the maximum. If the user considers the scale not to be appropriate, the maximum, minimum and major step can be changed.

⑦ Plot Characteristics

In order to see a curve on the plot, the 'Normal Line' option has to be checked. The color and line thickness can be changed as the user desires.

⑧ Manual

If any help is needed, the manual is automatically accessible through the Manual button. Please note that Adobe Acrobat 5.0 must be installed with the following path: C:\Program Files\Adobe\Acrobat 5.0\Acrobat\Acrobat.exe.

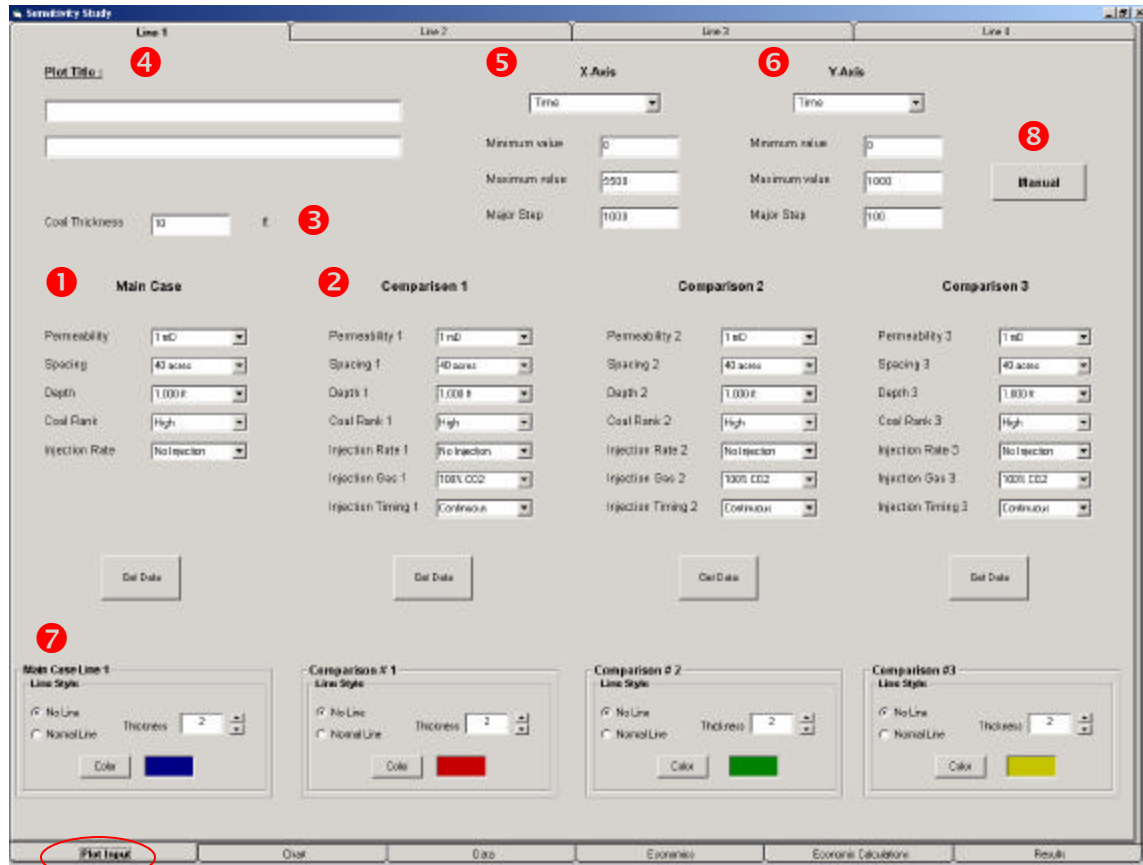


Figure 3: Model Screen Shot *Plot Input (a)*

More than only one parameter can be plotted by selecting new parameters for each axis on the tabs *Line 2*, *Line 3* and *Line 4*. As explained before, fourteen parameters can be selected for the X and Y-axis (Figure 4). A new option, the Line Style is here available (Figure 4). Due to a restriction of Visual Basic, this option only works for a line thickness of 1; any other thickness will automatically draw a solid line.

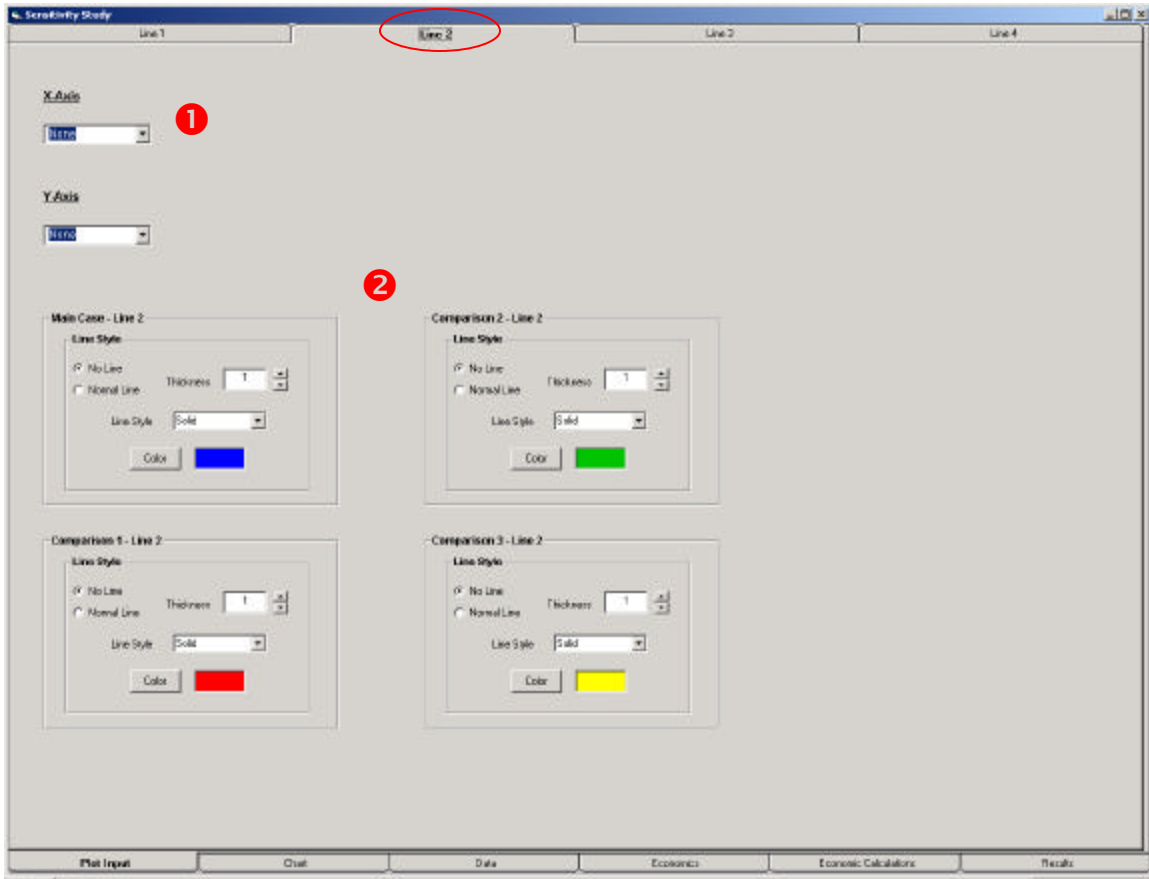


Figure 4: Model Screen Shot *Plot Input (b)*

3.2.2 Chart

After having selected all desired parameters, the user will be able to view and print out plots (Figure 5). Click the 'Plot' button to view the graph, as well as each time any parameter is changed, as the graph will not be automatically updated. The printout will show the plot and the legend.

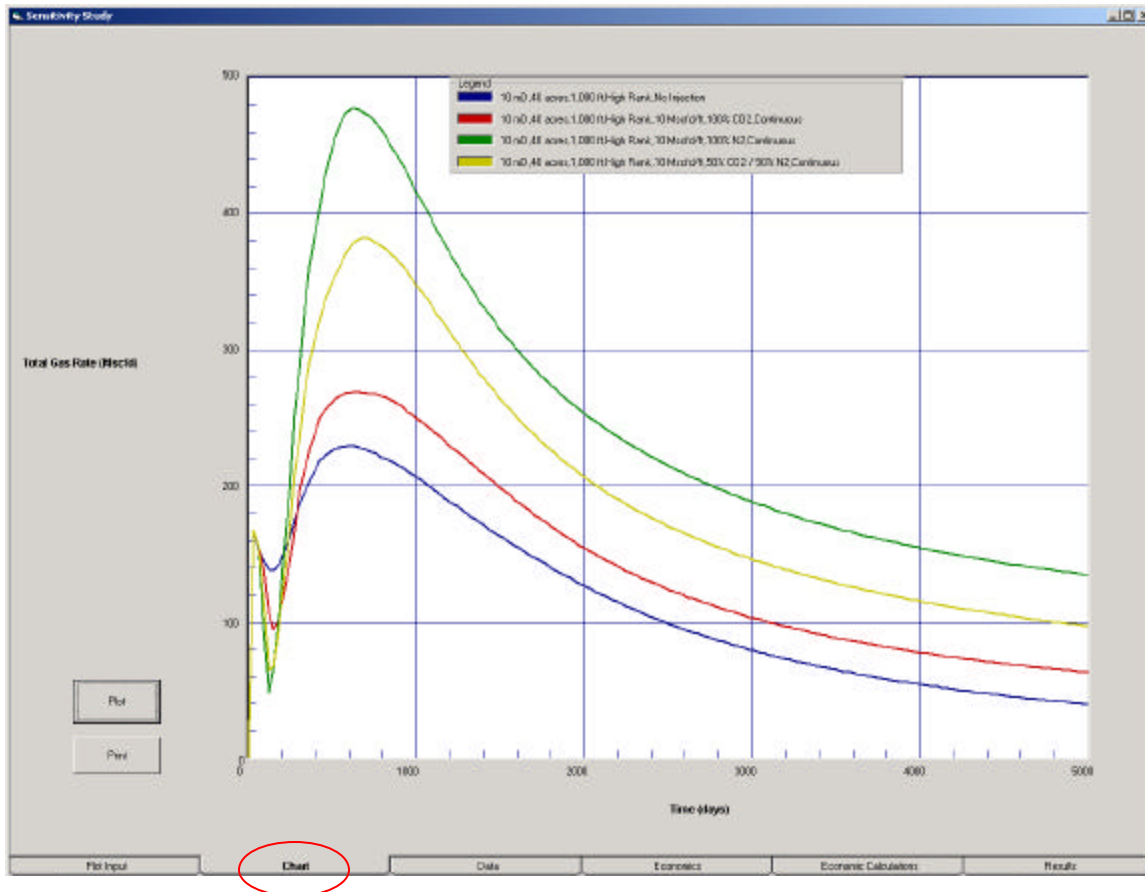


Figure 5: Model Screen Shot Chart

Note: the format for the printout can only be “Landscape”; the user cannot change this option.

Important Note: All the simulations have been run on a ¼ five spot basis for a thickness of 10 feet, but the necessary corrections have been made so that the plots represent an entire well. However, the data under the Data tab are directly coming out of the simulations so are for ¼ of a well in a 10 feet coal (i.e., they will not directly correspond to the values on the plot).

3.2.3 Data

Four tables allow looking at the data for each case. Each table is composed of the following fields:

- Time elapsed
- Cumulative CH₄ produced
- Cumulative N₂ produced
- Cumulative CO₂ produced
- Cumulative N₂ injected
- Cumulative CO₂ injected
- CH₄ gas rate
- N₂ gas rate
- CO₂ gas rate
- N₂ injection rate
- CO₂ injection rate

Note again that all these data are for ¼ of a well in a 10 feet coal.

3.2.3.1 Exporting Data

For each case, the data can be exported as a .csv (Microsoft Excel Comma Separated Values File) using the ‘Export Data to CSV’ button. The data will be automatically saved in the folder CoalSeq containing the executable as *filename.coalseq.csv* where the file name is assigned as explained below.

Each case can depend on up to seven parameters.

The first letter represents the permeability.

The letter ‘a’ will be assigned to a permeability of 1 mD.

The letter ‘b’ will be assigned to a permeability of 10 mD.

The letter ‘c’ will be assigned to a permeability of 100 mD.

The second letter represents the spacing.

The letter ‘a’ will be assigned to a spacing of 40 acres.

The letter ‘b’ will be assigned to a spacing of 160 acres.

The letter ‘c’ will be assigned to a spacing of 640 acres.

The third letter represents the depth.

The letter ‘a’ will be assigned to a depth of 1,000 feet.

The letter ‘b’ will be assigned to a depth of 5,000 feet.

The letter ‘c’ will be assigned to a depth of 10,000 feet.

The fourth letter represents the coal rank.

The letter ‘a’ will be assigned to a high coal rank.

The letter ‘b’ will be assigned to a medium coal rank.

The letter ‘c’ will be assigned to a low coal rank.

The fifth letter represents the injection rate (if injection).

The letter ‘a’ will be assigned to a 10 Mscfd/ft injection rate.

The letter ‘b’ will be assigned to a 50 Mscfd/ft injection rate.

The letter ‘c’ will be assigned to a 100 Mscfd/ft injection rate.
The letter ‘d’ will be assigned to a non-injection case.

The sixth letter represents the injection gas (if injection).
The letter ‘a’ will be assigned to a 100% CO₂ injection.
The letter ‘b’ will be assigned to a 100% N₂ injection.
The letter ‘c’ will be assigned to a 50% CO₂ / 50% N₂ injection.

The last letter represents the injection timing (if injection).
The letter ‘a’ will be assigned to an injection occurring the first 7.5 years.
The letter ‘b’ will be assigned to an injection occurring the second 7.5 years.
The letter ‘c’ will be assigned to a continuous injection for 15 years.

To illustrate, if the case is the following: 10 mD, 40 acres, 10,000 ft, high rank coal, 100% CO₂ continuous injection @ 100 Mscfd/ft; the file will be saved as bacacac.coalseq.csv. However, if this were a non-injection case, the last 2 parameters would be discarded. Let’s consider the case, as above but without injection; the file would then be saved as bacad.coalseq.csv.

Note: the exact same method has been used to name all the files in the database.

3.2.4 Economic Evaluation

In this section, how the performance data from the simulations can be converted into a cash flow analysis, depending upon assumptions on costs, expenses, revenues and taxes, is presented. The final results of the economic evaluation are the net present value, breakeven gas price and breakeven CO₂ cost (see ⑦ on Figure 6). Note that all computations are on a performed per-well basis. The results can then be upscaled to the desired project size (number of producers/injectors) “offline” by the user. The model assumes an injector-to-producer ratio of 1:1 (5-spot pattern).

All the economic calculations are made on an incremental basis between the main case and a comparison case that the user will define (see ① on Figure 6). Note that it also assumes the producer wells are already in-place, (hence the lack of operating expenses for production wells); only the capital and operating expenses for injection facilities/wells are required, as well as the incremental produced gas. The incremental CH₄ recovery can be viewed on the graph (*Plot* tab) by clicking the ‘Plot the CH₄ Incremental Recovery’ button followed by the ‘Plot’ button to update the data. The maximum and minimum values for the Y-axis are not automatically calculated; the user has to select them under the *Plot Input* tab.

The analysis extends over the duration of interest as defined by the user (see ② on Figure 6), but limited to a maximum 15 years.

The user must input four types of data (on a per-well basis):

③ Capital Expenses

- CO₂/N₂ Separation/Capture costs (\$/well)
- CO₂/N₂ Pipeline/Distribution costs (\$/well)
- Injection Well cost (\$/well)

These values are allocated to a single well.

④ Operating Expenses

- Injector well operating (\$/month/well) considered being null if the incremental injection rate is null.
- Cost of the injected gas (\$/Mcf). For a mixture, this cost should be the average price of CO₂ and N₂.
- CO₂/N₂ transportation and compression costs (\$/Mcf)
- Cost of the (incremental) produced gas processing (\$/Mcf)

⑤ Pricing

- Gas price (\$/MMBTU)
- Methane BTU Content (MMBTU/Mcf)

⑥ Financial

- Net Revenue Interest (%)
- Production Taxes (%)
- Discount Rate (%)
- CO₂ Incentive (\$/ton)

Figure 6: Model Screen Shot *Economics*

The screenshot displays the 'Economics' section of a software interface. It is organized into several panels:

- Selection Panel:** Includes a 'Please choose the second case needed for the economic evaluation:' section with radio buttons for 'Main Case', 'Comparison 1', 'Comparison 2', and 'Comparison 3'. A 'Plot the EMI Incremental Recovery' button is also present. The 'Evaluation Time' is set to '15' years, with a note '(Maximum 15 years)'.
- Input Data Panel:** Contains three input fields: 'CO₂/N₂ Separation/Capture' (15000 \$/well), 'CO₂/N₂ Pipeline/Distribution' (2000 \$/well), and 'Inj Well Unit Cost' (20000 \$/well). A note below states '* Allocated to single well'.
- Oper Panel:** Includes 'Injector Well Operating' (0 \$/Month/well), 'Cost of injected Gas' (0 \$/well), 'Produced Gas Processing' (0.25 \$/Mcf), and 'CO₂ Transportation / Compression' (0.1 \$/Mcf).
- Pricing Panel:** Includes 'Gas Price' (0.2 \$/MMBTU) and 'Methane BTU Content' (104 MMBTU/Mcf).
- Financial Panel:** Includes 'Net Revenue Interest' (20.5 %), 'Production Taxes' (0 %), 'Discount Rate' (12 %), and 'CO₂ Incentive' (0 \$/ton).
- Results Panel:** Features a 'Results' button, a 'Print Results' button, and three output fields: 'Economic Gas Price' (\$/MMBTU), 'Economic CO₂ Cost' (\$/Mcf), and 'Net Present Value' (million \$).

The 'Economics' tab is highlighted in the bottom navigation bar.

After entering the required information, clicking the “Results” button will execute the calculations and return the results.

Remark: the breakeven gas price and breakeven CO₂ price are computed using a loop so the results will not be immediate, they will appear after a few seconds. The results can then be printed if desired. The printout will show the parameters of the two cases used for the analysis, all the input data and the results. In addition, a detailed cash flow table is provided under the *Economic Calculations* tab. An example is shown on Figure 7.

	Incremental Revenue				Opex					Cash Flow				
	Gross Revenue	Revenue	Production Taxes	Net Revenue	Depositing Costs	CO2/CH4 Costs	Processing	Transportation/Compression	Total Opex	CO2 Incentive	Net Income	Total	PV	Cum PV
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	136	-7	-5	124		347	15	115	1477		-1001	-1081	981	-20581
3	422	24	17	-379		381	-46	243	2728		-2507	-2529	-2475	-51470
4	2257	128	56	-2034			-346		1371		-4002	-4082	-3940	-53580
5	3026	172	126	-2736			-371		1886		-4622	-4623	-4597	-64297
6	2758	156	116	-2486			-301		1316		-4432	-4442	-4146	-74743
7	3024	115	86	-1924			221		1896		-3620	-3620	-3562	-85075
8	1291	72	53	-1148			-126		2676		-3204	-3204	-2577	-95382
9	559	30	24	-534			-64		2723		-2697	-2697	-2495	-106130
10	253	20	22	-165			71		2288		-1494	-1494	-1634	-116762
11	1173	62	48	-735			126		2196		-1282	-1282	-1148	-128275
12	1559	56	67	-1432			174		2391		893	893	893	-139275
13	1881	-101	-79	-1699			232		2423		-726	-726	-673	-150192
14	2150	-124	-92	-1377			228		2499		-479	-479	-436	-160320
15	2385	-124	-99	-1122			398		2676		-282	-282	-295	-161023
16	2459	-128	-103	-1217			268		2695		-269	-269	-228	-161211
17	2488	-142	-106	-1252			273		2490		236	236	280	-161451
18	2630	-145	-111	-1373			267		2504		121	121	184	-161560
19	2728	-158	-115	-1466			256		2515		57	57	47	-161627
20	2756	-158	-116	-1484			301		2518		-34	-34	-27	-161638
21	2929	-168	-118	-1550			309		2620		34	34	99	-161542
22	2978	-165	-121	-1622	1000		319		2522		57	57	89	-161573
23	2965	-168	-128	-1692		912	326	304	2543		147	147	178	-161458
24	3047	-173	-126	-1716			322		2590		196	196	182	-161282
25	3128	-172		-1815			352		2792		261	261	280	-161186
26	3138			-1825			342		2680		295	295	295	-160981
27	3137	-178	-130	-1827					2680		251	251	262	-160639
28	3124	-177		-1815			341		2558		297	297	182	-160287
29	3125			-1817					2593		294	294		-160275
30	3047	-173	-128	-1746			332		2793		196	196	143	-160172
31	2996	-178	-128	-1700			327		2544		196	196	113	-159269
32	2974	-165	-125	-1698			325		2542		138	138	94	-159480
33	2958	-178	-128	-1702			327		2544		196	196	112	-159348
34	2980	-168	-128	-1698			326		2542		185	185	182	-159246
35	2863	-168	-125	-1672			324		2541		131	131	91	-159235
36	2862	-167	-124	-1661			322		2539		122	122	84	-159271
37	2859	-168	-125	-1668			323		2540		126	126	86	-159485
38	2871	-162	-121	-1629			312		2530		97	97	35	-159347
39	2822	-168	-118	-1592			308		2629		16	16	12	-159425
40	2783	-154	-117	-1508			304		2621		-13	-13	-5	-159344
41	2773	-157		-1496			302		2620		-22	-22	-4	-159347
42	2754	-158	-118	-1482			317		2518		-36	-36	-23	-159480
43	2692	-153	-113	-1406			294		2511		-89	-89	-54	-159204

When the same numeric value exists for multiple lines, the value is displayed only once and the cells are merged as shown

Figure 7: Model Screen Shot *Economic Calculations*

3.2.5 Results

Finally, a table is provided that summarizes the results of the comparison (Figure 8). The results table includes (when applicable):

- The total CH₄ recovery
- The incremental CH₄ recovery (increment from the non-injection case)
- The percentage improvement over primary production
- The total sequestration volume (only if CO₂ is injected)

The screenshot shows a software window titled "Sensitivity Study". Inside, there is a table with the following data:

	Total CH4 Recovery	Incremental CH4 Recovery	% Improvement Over Primary	Total Sequestration Volume	
	(Mscf)	(Mscf)	(%)	(Mscf)	(Ton)
No Injection	591340	n/a	n/a	n/a	n/a
Comparison 1*	731304	139964	24	533600	91202
Comparison 2*	866028	254688	43	0	0
Comparison 3*	803848	212508	36	269900	15681

Below the table are two buttons: "Results" and "Print Results". At the bottom of the window, there is a navigation bar with tabs for "Por Input", "Oval", "Data", "Economics", "Economic Calculations", and "Results". The "Results" tab is circled in red.

Figure 8: Model Screen Results

The results table can be printed if desired.

3.3 Help

For any comments or questions, please contact Anne Taillefert or Scott Reeves by phone or e-mail.

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Scott Reeves: sreeves@adv-res-hou.com

3.4 Frequently Asked Questions

- I cannot run the model from the CD.

The model cannot be run from the CD, it has to be installed on your computer as explained in chapter 3.1 (Installation) on page 6 of this manual as well as on the inside cover of the CD case.

- I get an error message when I hit the ‘Start’ button.

Some people got the following error message: “ Runtime Error 339: The component MSHFLXGD.OCX and its dependencies are missing or cannot be found.” The following components, MSHFLXGD.OCX, COMCAT.DLL AND MSSTDFMT.DLL are missing and need to be installed on your computer.

Please follow the instructions from the Microsoft web site provided in the following link.

<http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnaskdr/html/askgui05152001.asp>

4.0 References

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