SAND2006-0082P

Carbon Sequestration: The Integrated Assessment Overview

Peter H. Kobos, Leonard A. Malczynski and David J. Borns

Sandia National Laboratories

Southwest Regional Partnership on Carbon Sequestration

Integrated Assessment Activities:
Test Case and 'String of Pearls' Modeling and Analysis 2005

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000

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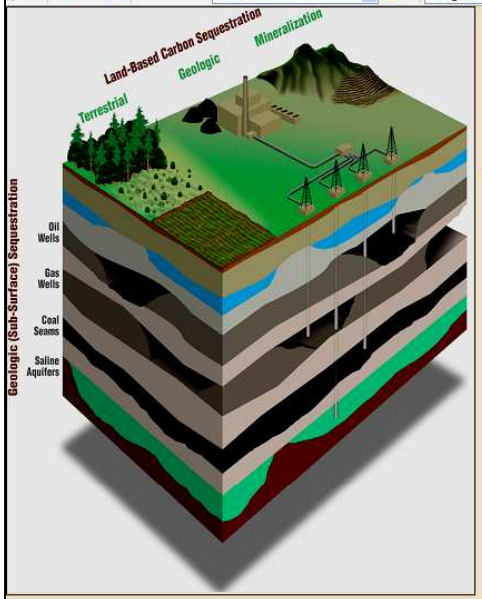
Southwest Regional Partnership on Carbon Sequestration Integrated Assessment Model: Test Case



SOUTHWEST REGIONAL PARTNERSHIP FOR CARBON SEQUESTRATION: The String of Pearls

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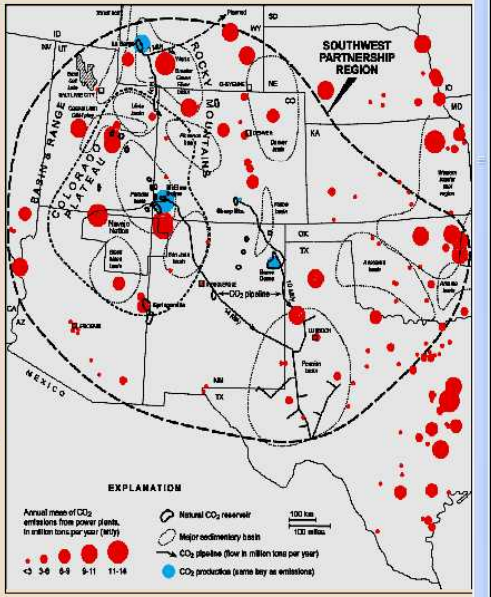
Prototype Version 1.0
December 2005

Click Here to Continue



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Southwest Regional Partnership on Carbon Sequestration Integrated Assessment Model: Test Case

Home | String of Pearls | Systems Results | Map

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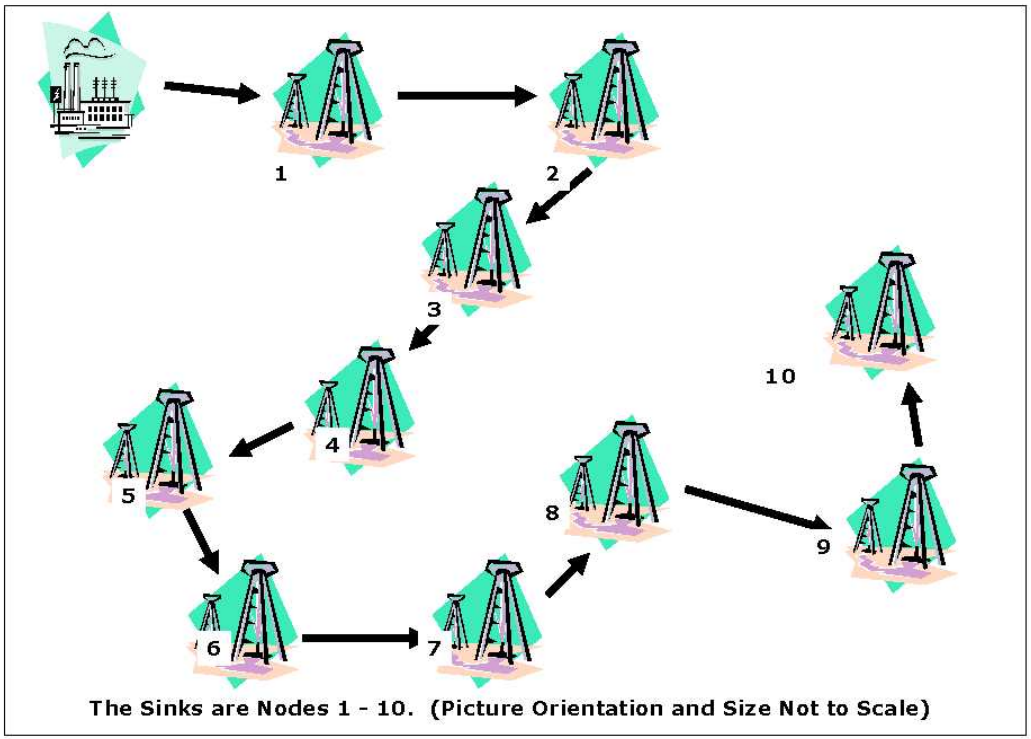
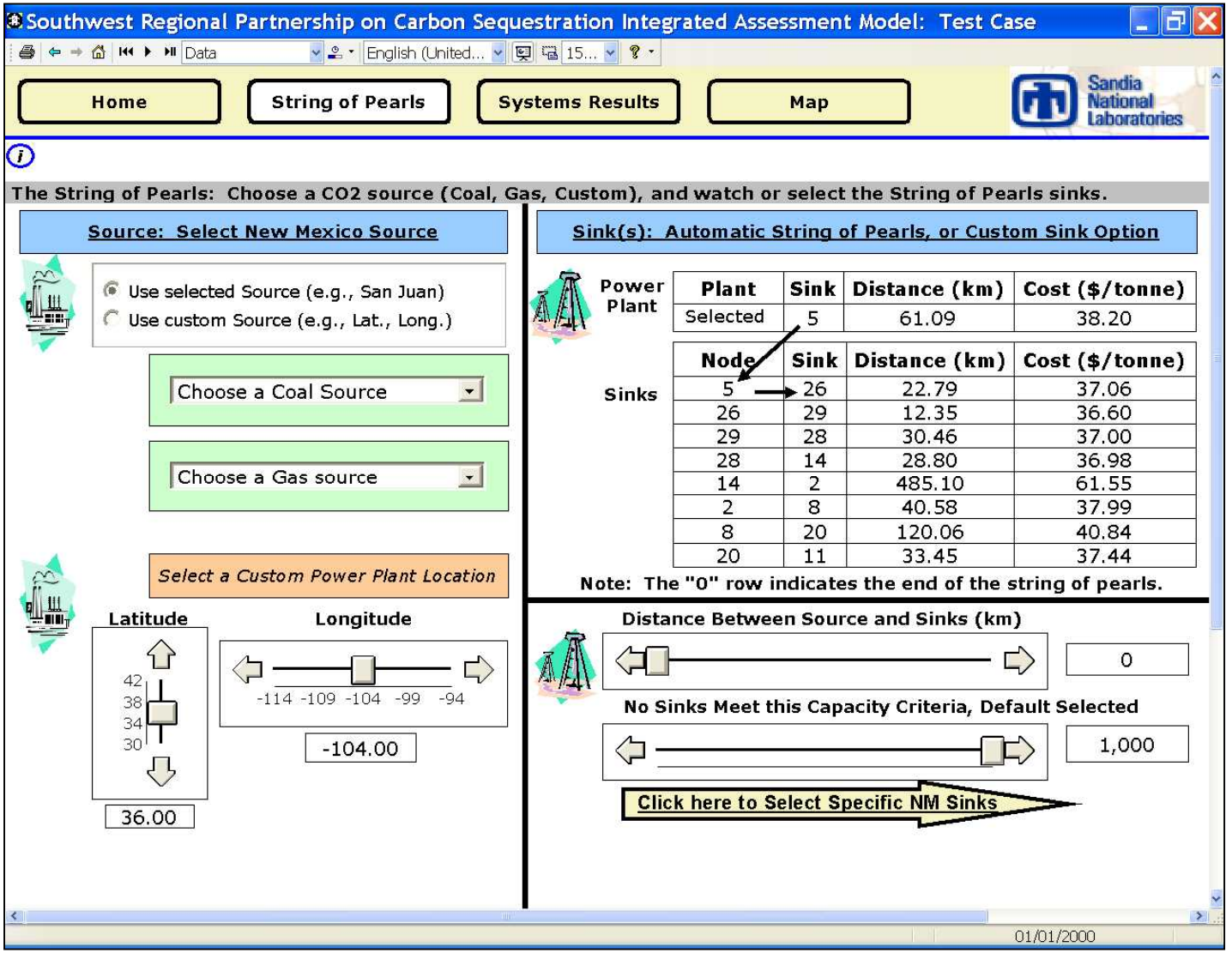
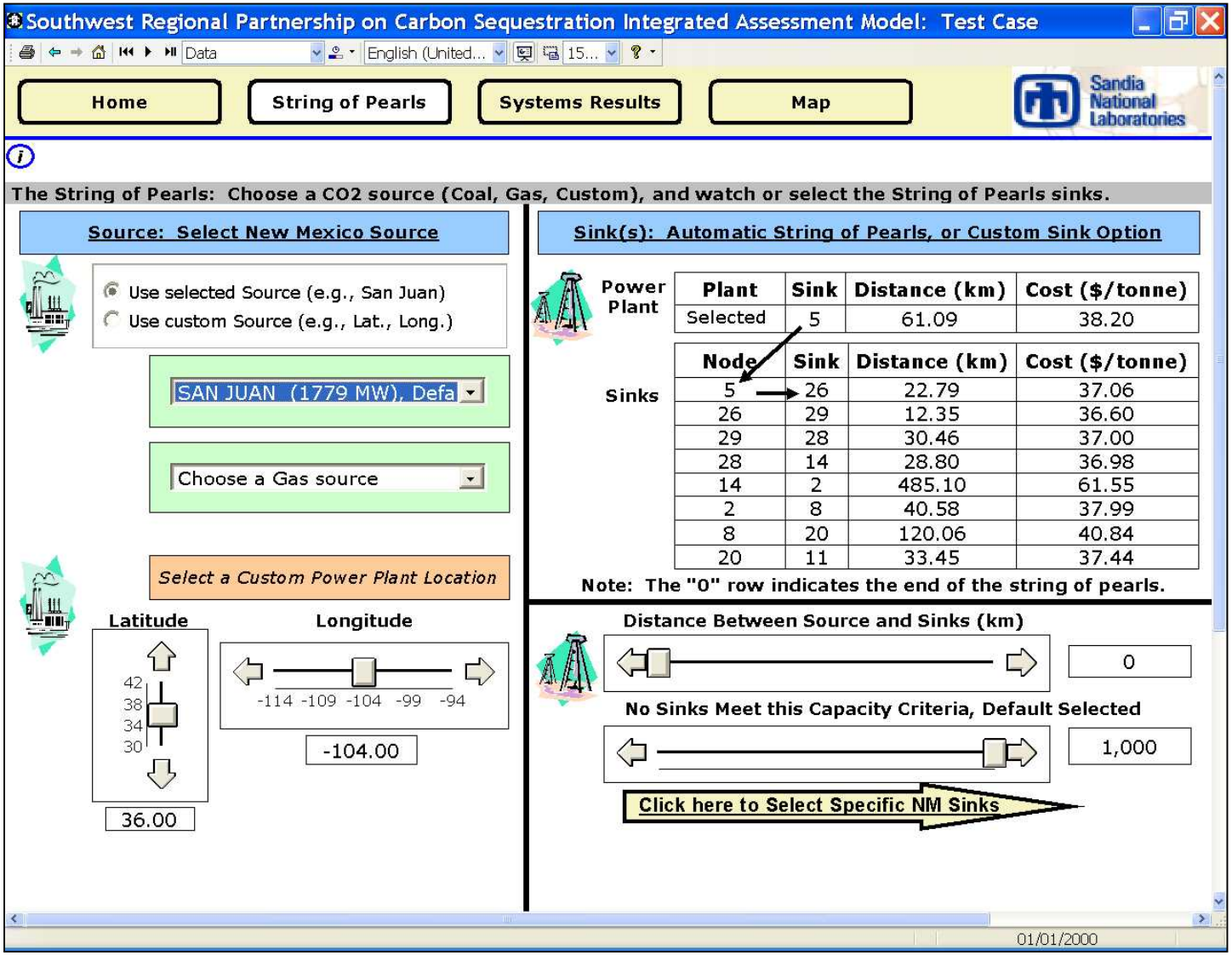
The String of Pearls: The model calculates the shortest distance from a power plant (CO2 source) to the sinks.



The Sinks are Nodes 1 - 10. (Picture Orientation and Size Not to Scale)

01/01/2000


Southwest Regional Partnership on Carbon Sequestration Integrated Assessment Model: Test Case
Home
String of Pearls
Systems Results
Map
Sandia National Laboratories
The String of Pearls: Choose a CO2 source (Coal, Gas, Custom), and watch or select the String of Pearls sinks.
Source: Select New Mexico Source
Use selected Source (e.g., San Juan)
Use custom Source (e.g., Lat., Long.)
Choose a Coal Source
Choose a Gas source
Select a Custom Power Plant Location
Latitude
42
38
34
30
36.00
Longitude
-114 -109 -104 -99 -94
-104.00
Sink(s): Automatic String of Pearls, or Custom Sink Option
Power Plant
Plant | Sink | Distance (km) | Cost ($/tonne)
Selected | 5 | 61.09 | 38.20
Sinks
Node | Sink | Distance (km) | Cost ($/tonne)
5 | 26 | 22.79 | 37.06
26 | 29 | 12.35 | 36.60
29 | 28 | 30.46 | 37.00
28 | 14 | 28.80 | 36.98
14 | 2 | 485.10 | 61.55
2 | 8 | 40.58 | 37.99
8 | 20 | 120.06 | 40.84
20 | 11 | 33.45 | 37.44
Note: The "0" row indicates the end of the string of pearls.
Distance Between Source and Sinks (km)
0
No Sinks Meet this Capacity Criteria, Default Selected
1,000
Click here to Select Specific NM Sinks
01/01/2000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Source: Select New Mexico Source
Use selected Source (e.g., San Juan)
Use custom Source (e.g., Lat., Long.)
SAN JUAN (1779 MW), Defa
Choose a Gas source
Select a Custom Power Plant Location
Latitude
42
38
34
30
36.00
Longitude
-114 -109 -104 -99 -94
-104.00
Sink(s): Automatic String of Pearls, or Custom Sink Option
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1,000
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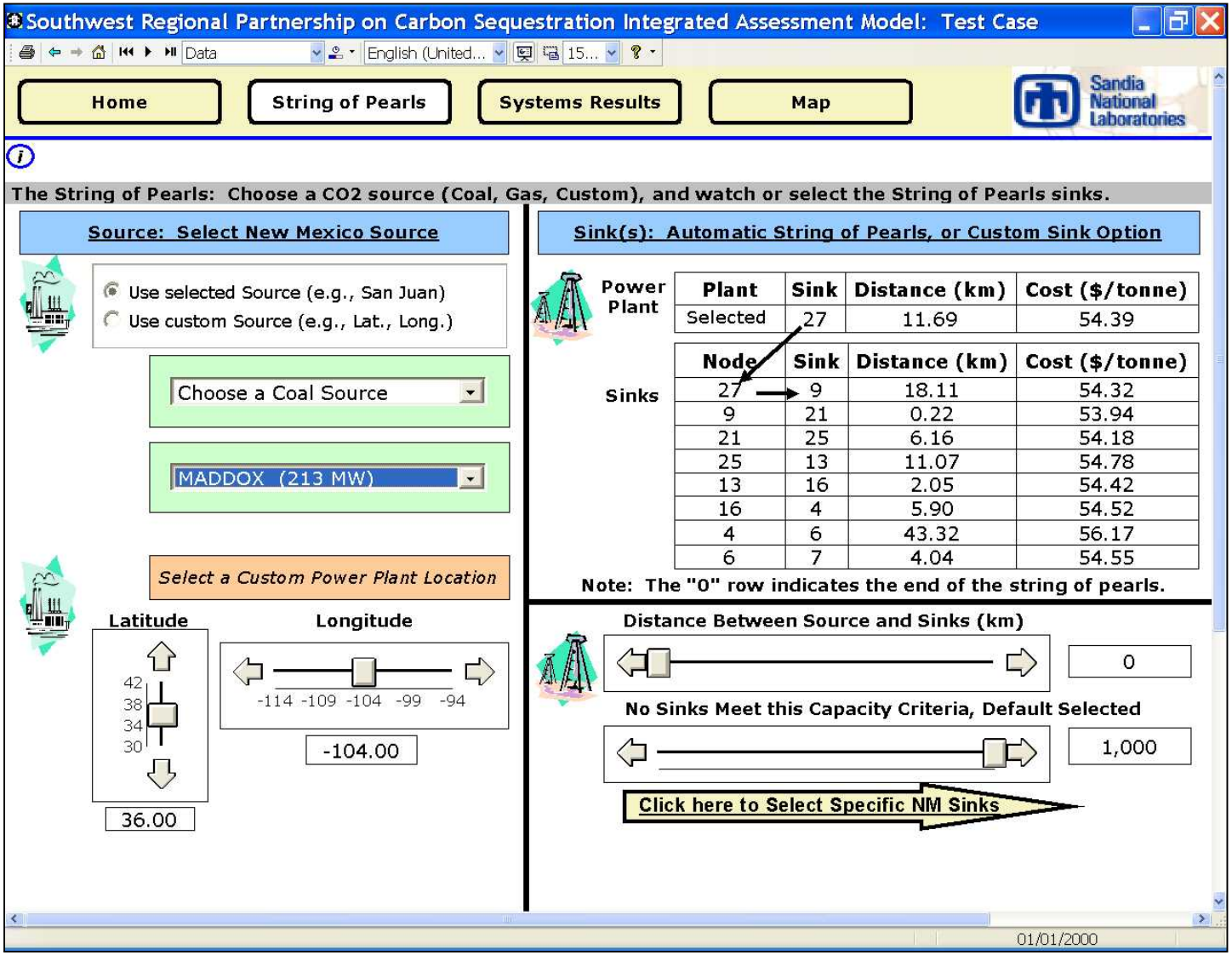
01/01/2000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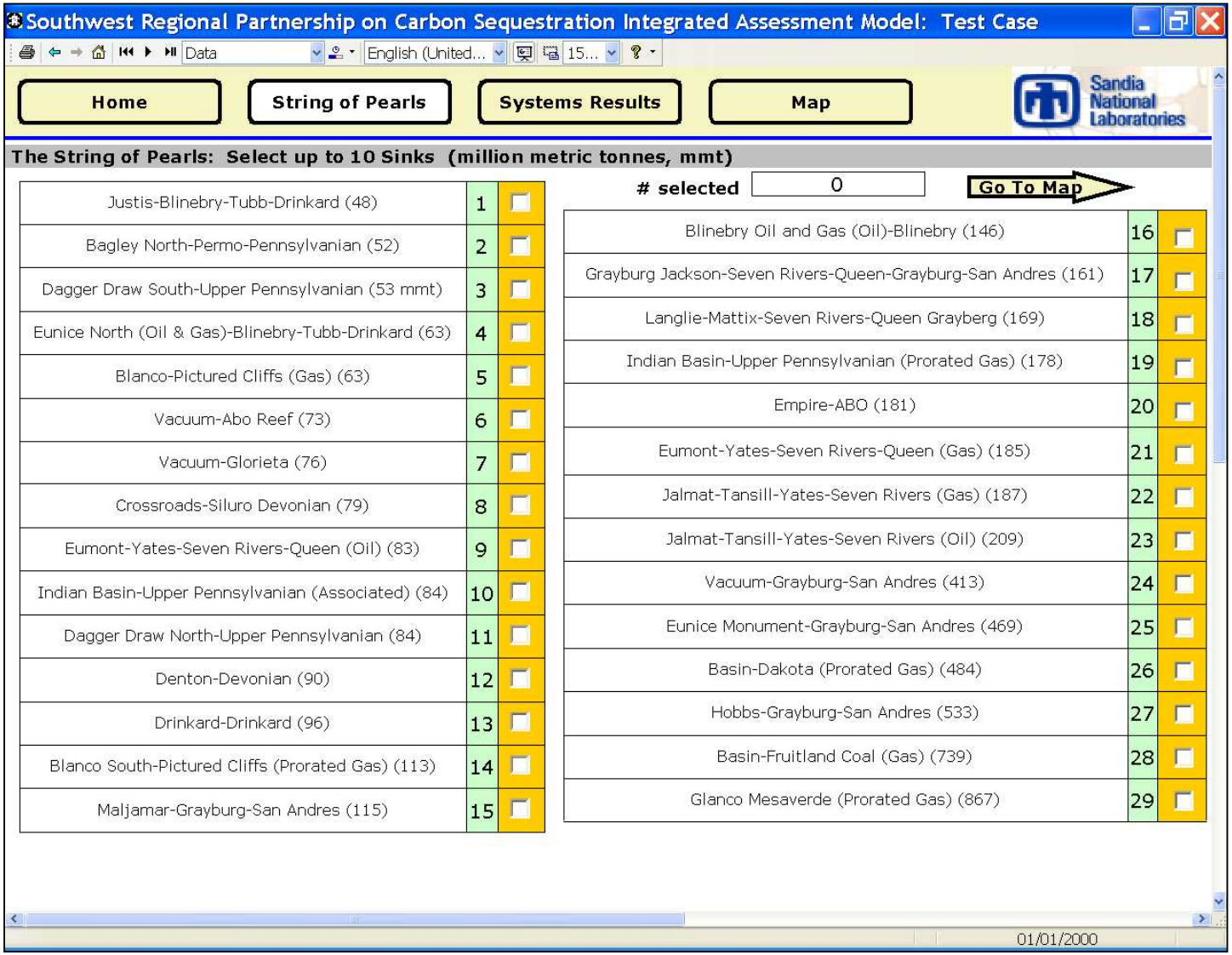
Source: Select New Mexico Source
Use selected Source (e.g., San Juan)
Use custom Source (e.g., Lat., Long.)
Choose a Coal Source
MADDOX (213 MW)
Select a Custom Power Plant Location
Latitude
42
38
34
30
36.00
Longitude
-114 -109 -104 -99 -94
-104.00
Sink(s): Automatic String of Pearls, or Custom Sink Option
Power Plant
Plant | Sink | Distance (km) | Cost ($/tonne)
Selected | 27 | 11.69 | 54.39
Sinks
Node | Sink | Distance (km) | Cost ($/tonne)
27 | 9 | 18.11 | 54.32
9 | 21 | 0.22 | 53.94
21 | 25 | 6.16 | 54.18
25 | 13 | 11.07 | 54.78
13 | 16 | 2.05 | 54.42
16 | 4 | 5.90 | 54.52
4 | 6 | 43.32 | 56.17
6 | 7 | 4.04 | 54.55
Note: The "0" row indicates the end of the string of pearls.
Distance Between Source and Sinks (km)
0
No Sinks Meet this Capacity Criteria, Default Selected
1,000
Click here to Select Specific NM Sinks
01/01/2000



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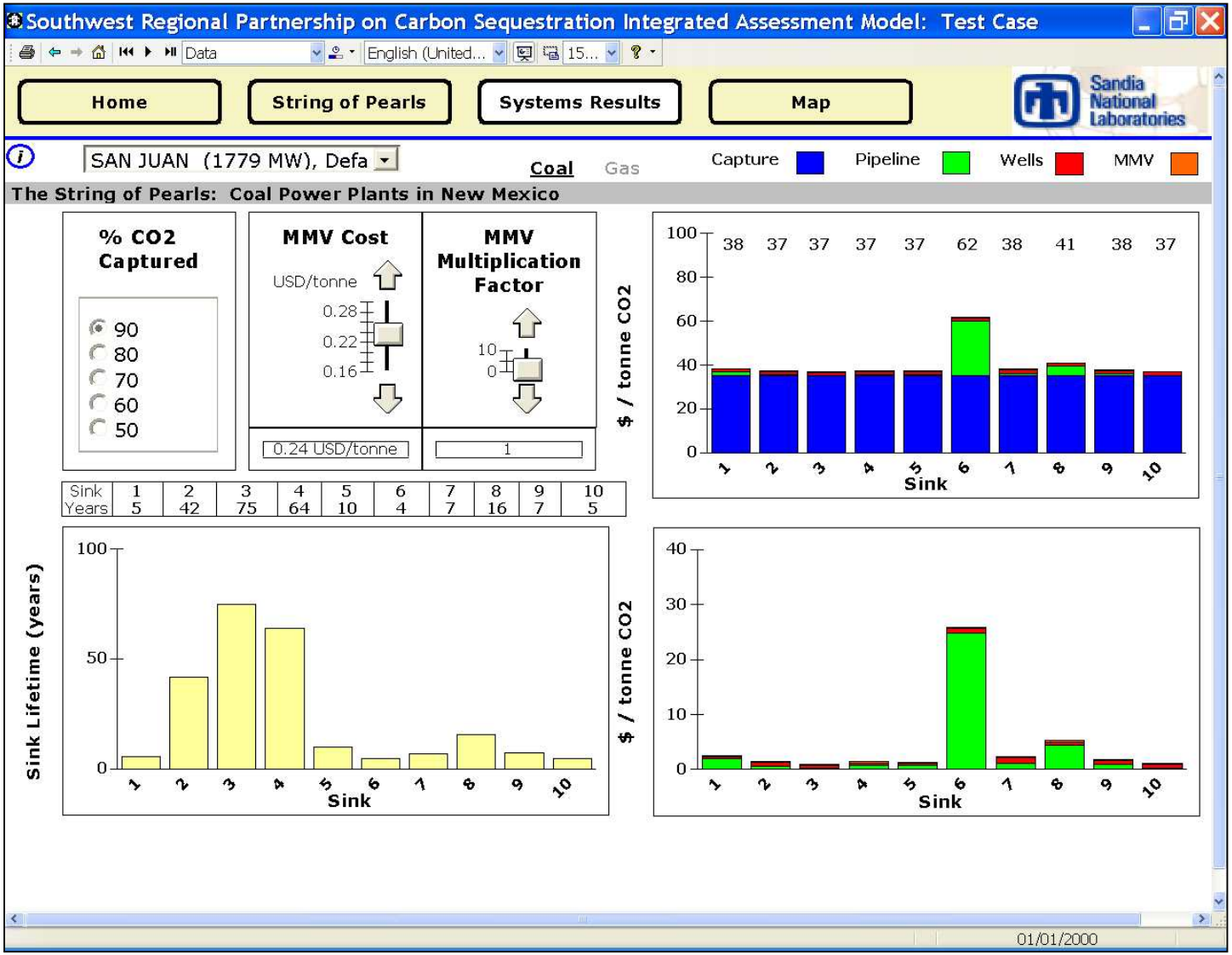
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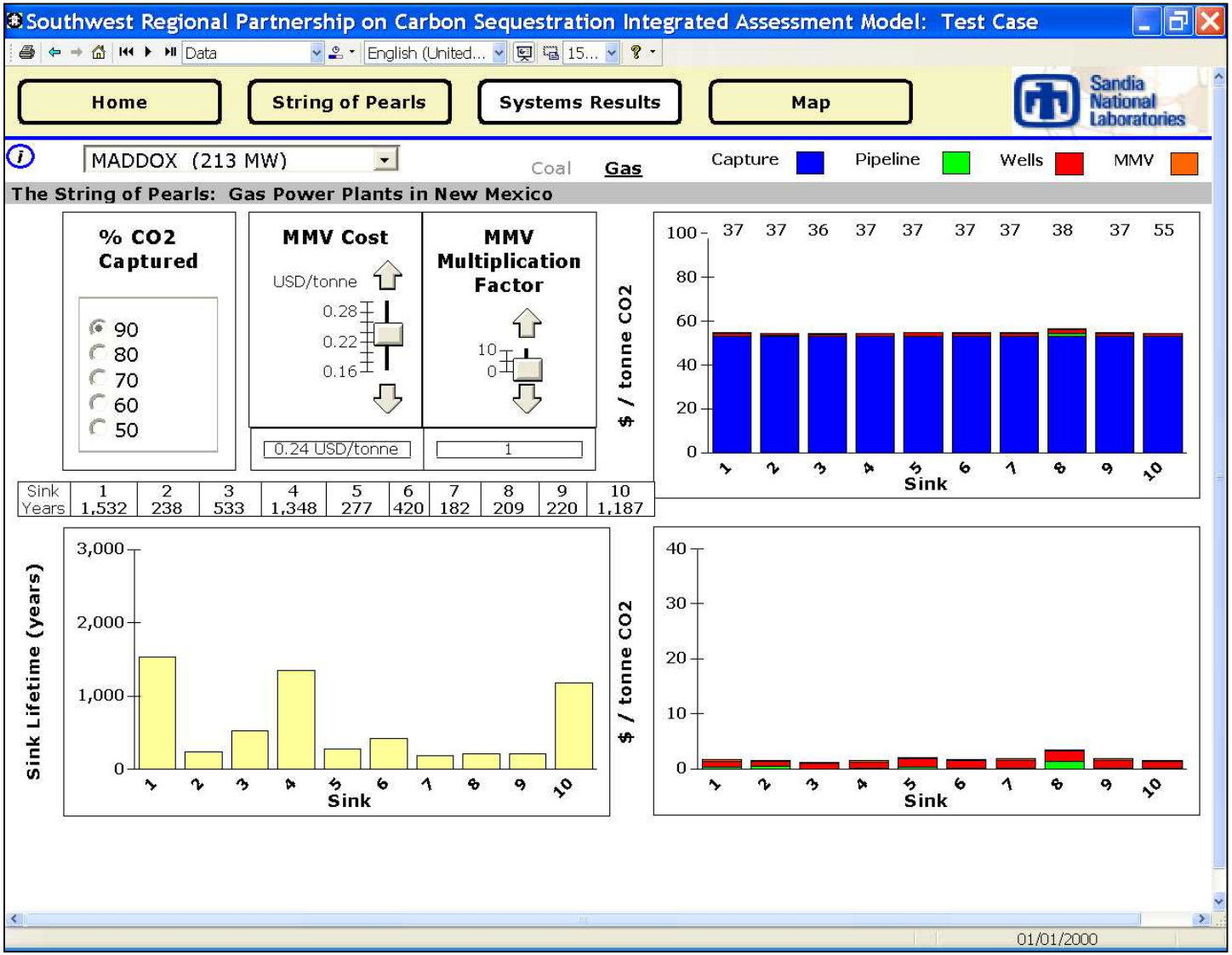
String of Pearls
Systems Results
Map
Sandia National Laboratories
SAN JUAN (1779 MW), Defa
Coal
Gas
Capture
Pipeline
Wells
MMV
The String of Pearls: Coal Power Plants in New Mexico
% CO2 Captured
90
80
70
60
50
MMV Cost
USD/tonne
0.28
0.22
0.16
0.24 USD/tonne
MMV Multiplication Factor
10
0
1
$ / tonne CO2
38 37 37 37 37 62 38 41 38 37
Sink
Sink 1 2 3 4 5 6 7 8 9 10
Years 5 42 75 64 10 4 7 16 7 5
Sink Lifetime (years)
Sink
$ / tonne CO2
Sink
01/01/2000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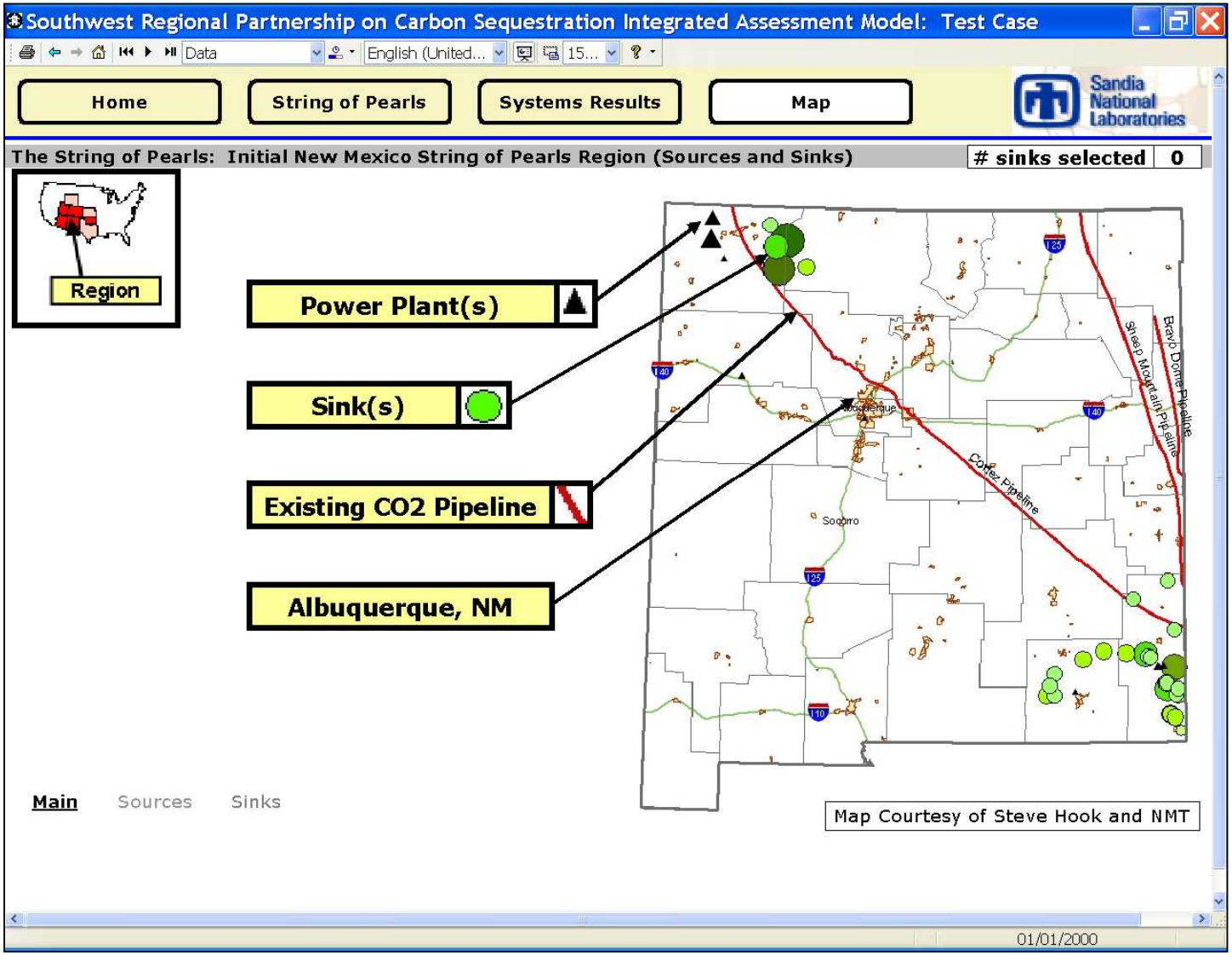
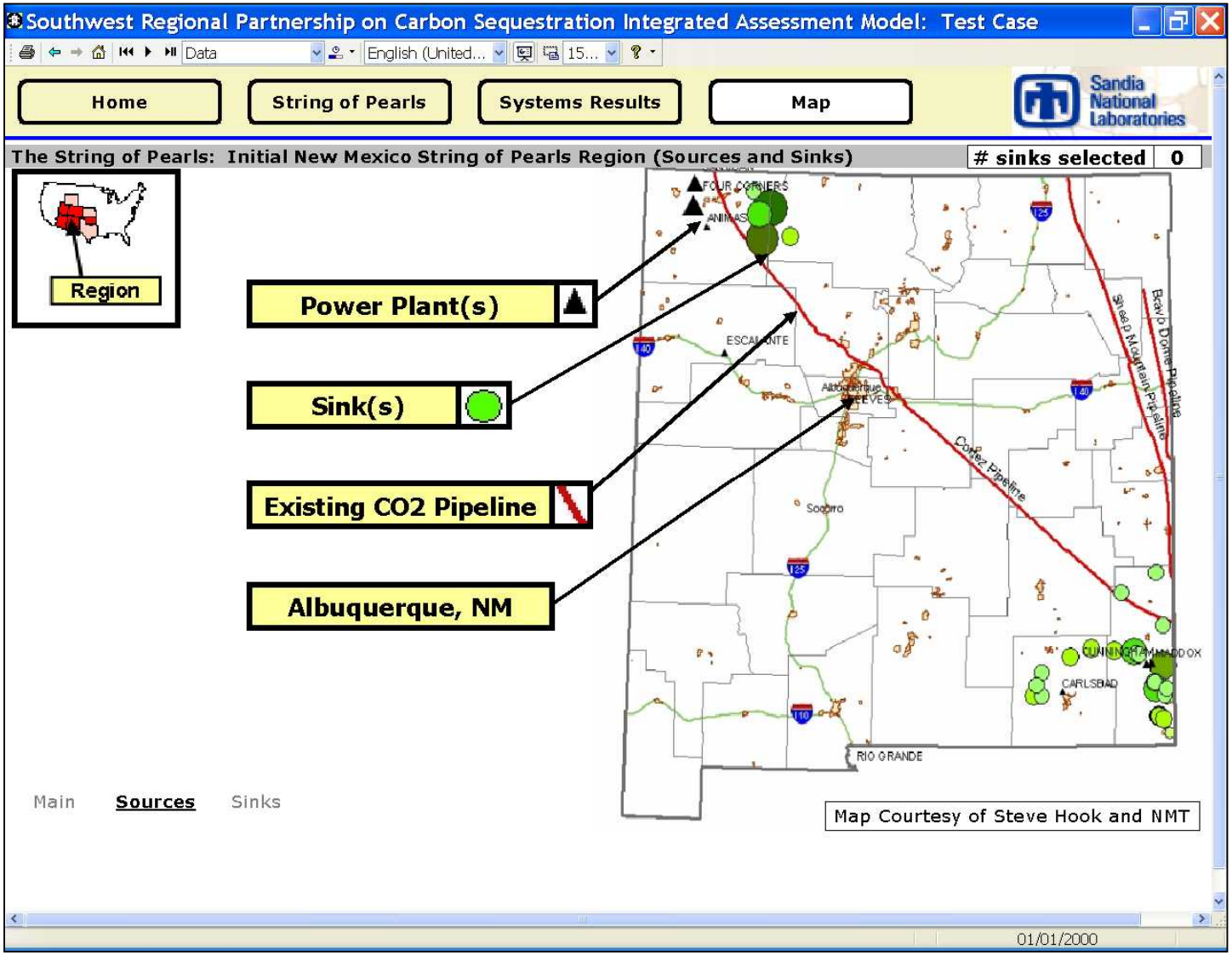
Map
Sandia National Laboratories
MADDOX (213 MW)
Coal
Gas
Capture
Pipeline
Wells
MMV
The String of Pearls: Gas Power Plants in New Mexico
% CO2 Captured
90
80
70
60
50
MMV Cost
USD/tonne
0.28
0.22
0.16
0.24 USD/tonne
MMV Multiplication Factor
10
0
1
$ / tonne CO2
100
80
60
40
20
0
37 37 36 37 37 37 37 38 37 55
1 2 3 4 5 6 7 8 9 10
Sink
Sink 1 2 3 4 5 6 7 8 9 10
Years 1,532 238 533 1,348 277 420 182 209 220 1,187
Sink Lifetime (years)
3,000
2,000
1,000
0
1 2 3 4 5 6 7 8 9 10
Sink
$ / tonne CO2
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10
Sink
01/01/2000


Southwest Regional Partnership on Carbon Sequestration Integrated Assessment Model: Test Case
Home
String of Pearls
Systems Results
Map
Sandia National Laboratories
The String of Pearls: Initial New Mexico String of Pearls Region (Sources and Sinks)
sinks selected 0
Region
Power Plant(s)
Sink(s)
Existing CO2 Pipeline
Albuquerque, NM
Albuquerque
Socorro
Bravo Dome Pipeline
Sheep Mountain Pipeline
Cortez Pipeline
Main
Sources
Sinks
Map Courtesy of Steve Hook and NMT
01/01/2000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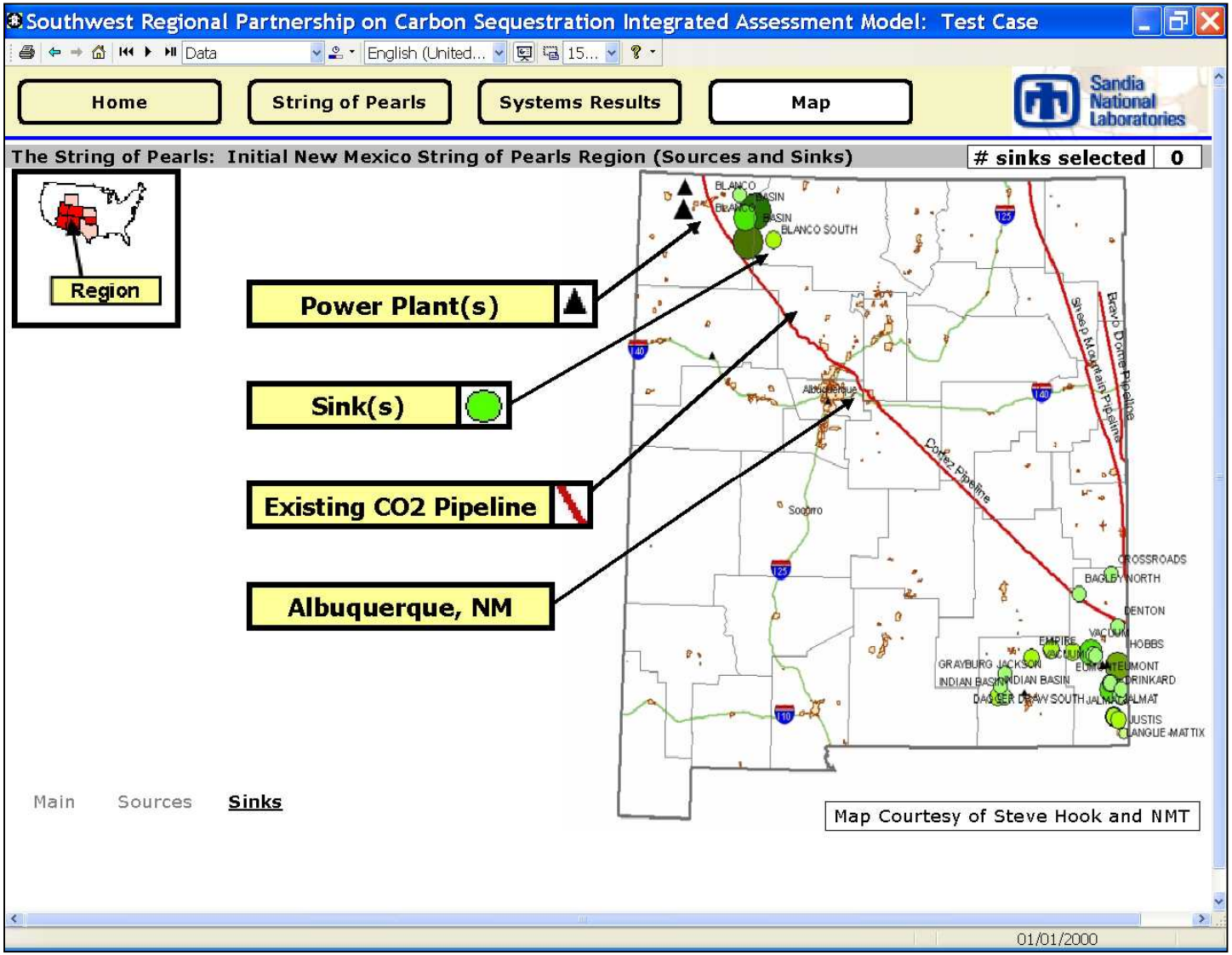
Sandia National Laboratories
The String of Pearls: Initial New Mexico String of Pearls Region (Sources and Sinks)
sinks selected 0
Region
Power Plant(s)
Sink(s)
Existing CO2 Pipeline
Albuquerque, NM
FOUR CORNERS
ANIMAS
ESCALANTE
Albuquerque
CLOVIS
Socorro
Bravo Dome Pipeline
Sheep Mountain Pipeline
Cortez Pipeline
CARLSBAD
RIO GRANDE
Main
Sources
Sinks
Map Courtesy of Steve Hook and NMT
01/01/2000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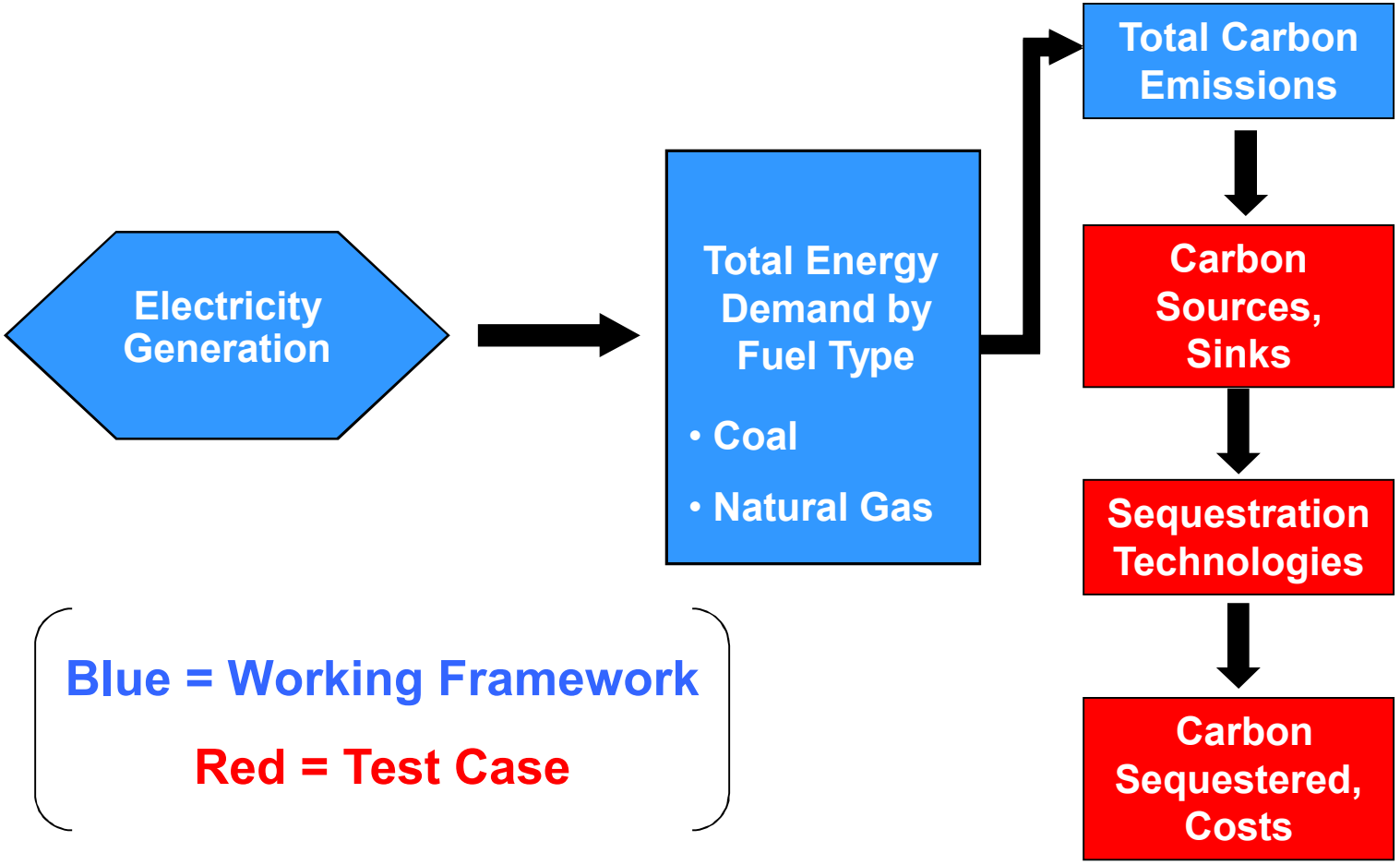
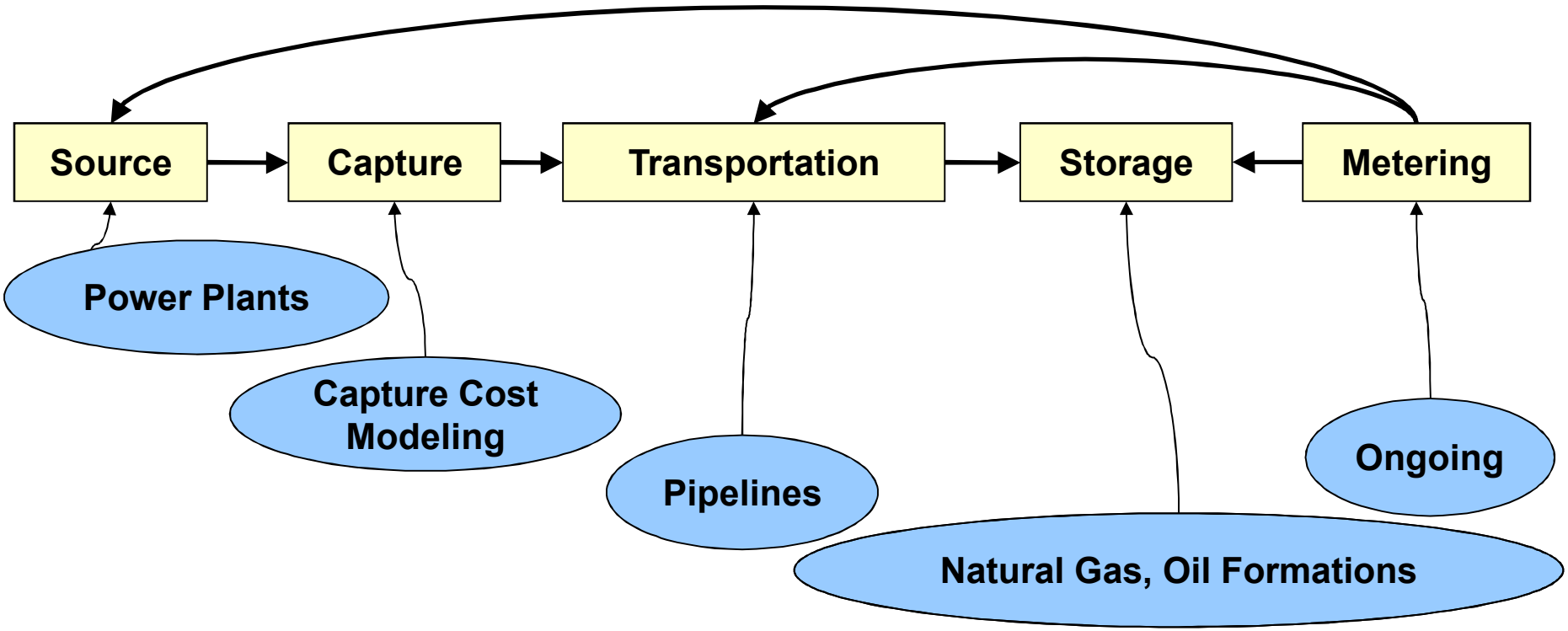
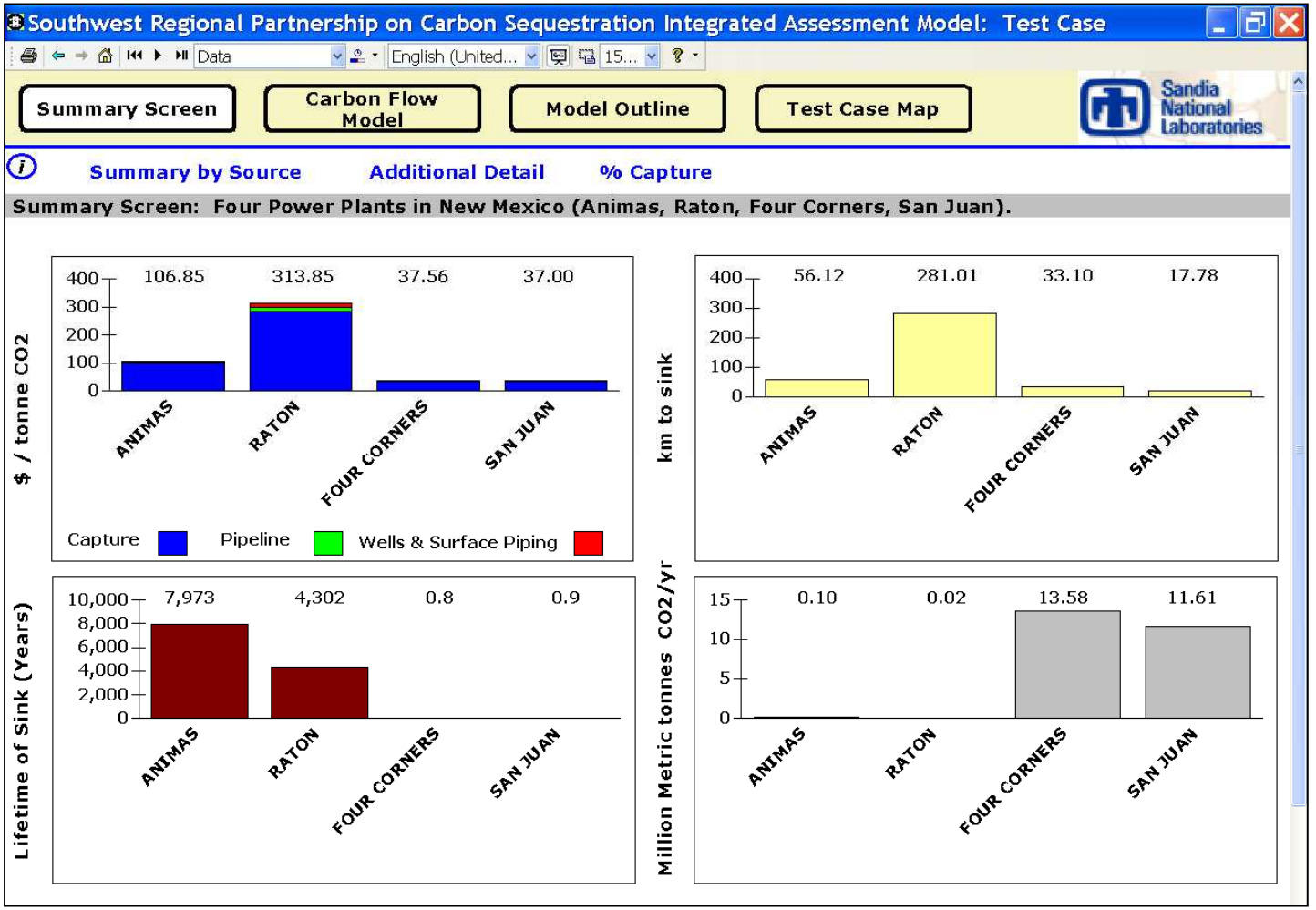
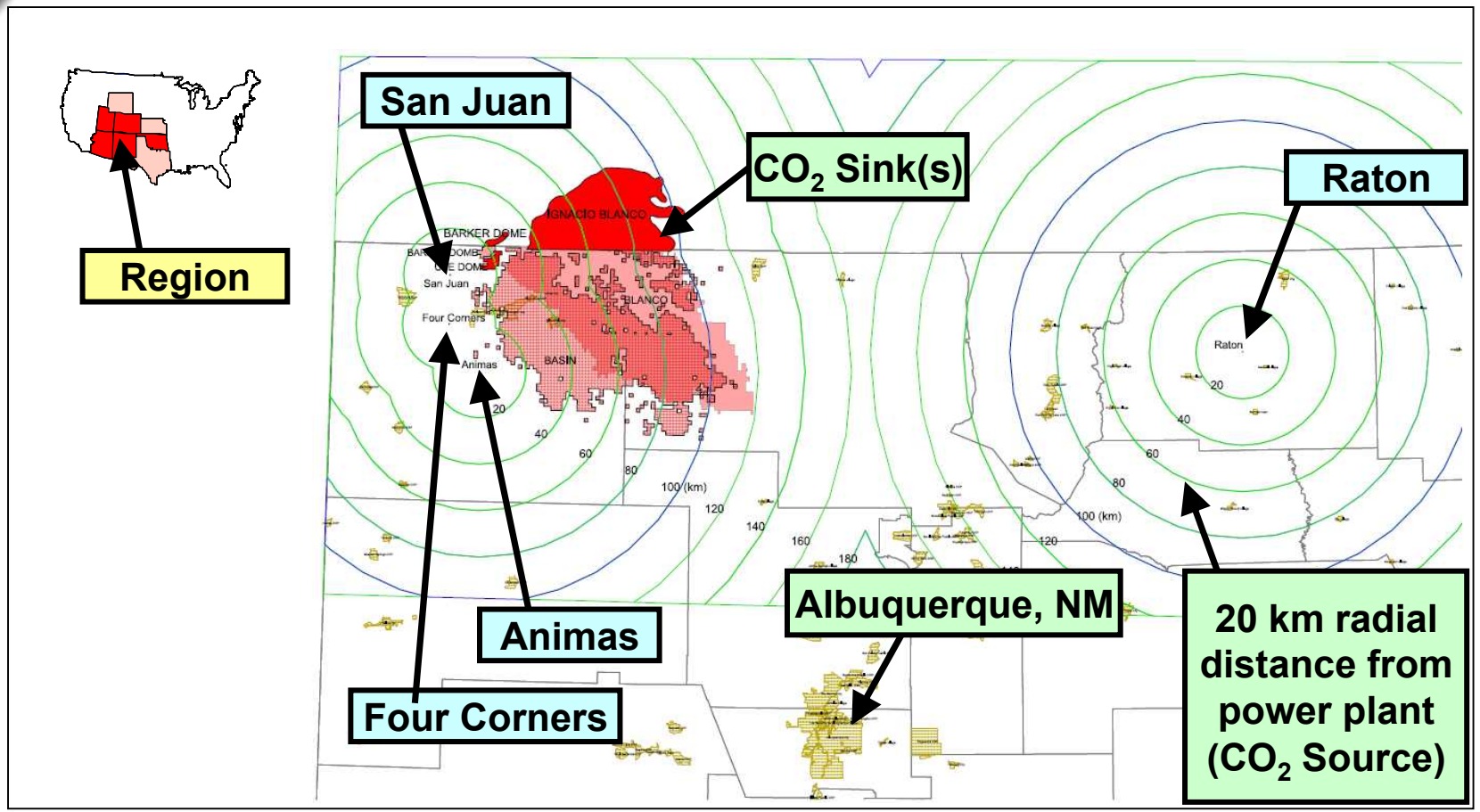
Systems Results
Map
Sandia National Laboratories
The String of Pearls: Initial New Mexico String of Pearls Region (Sources and Sinks)
sinks selected 0
Region
Power Plant(s)
Sink(s)
Existing CO2 Pipeline
Albuquerque, NM
BLANCO
BLANCO SOUTH
Albuquerque
Socorro
Bravo Dome Pipeline
Sheep Mountain Pipeline
Cortez Pipeline
CROSSROADS
BAGLEY NORTH
DENTON
VACUUM
HOBBS
EMPIRE
GRAYBURG JACKSON
INDIAN BASIN
DRINKARD
JUSTIS
Main
Sources
Sinks
Map Courtesy of Steve Hook and NMT
01/01/2000


Electricity Generation
Total Energy Demand by Fuel Type
• Coal
• Natural Gas
Total Carbon Emissions
Carbon Sources, Sinks
Sequestration Technologies
Carbon Sequestered, Costs
Blue = Working Framework
Red = Test Case


Source
Capture
Transportation
Storage
Metering
Power Plants
Capture Cost Modeling
Pipelines
Natural Gas, Oil Formations
Ongoing


Southwest Regional Partnership on Carbon Sequestration Integrated Assessment Model: Test Case
Summary Screen
Carbon Flow Model
Model Outline
Test Case Map
Sandia National Laboratories
Summary by Source
Additional Detail
% Capture
Summary Screen: Four Power Plants in New Mexico (Animas, Raton, Four Corners, San Juan).
$ / tonne CO2
106.85
313.85
37.56
37.00
ANIMAS
RATON
FOUR CORNERS
SAN JUAN
Capture
Pipeline
Wells & Surface Piping
km to sink
56.12
281.01
33.10
17.78
Lifetime of Sink (Years)
7,973
4,302
0.8
0.9
Million Metric tonnes CO2/yr
0.10
0.02
13.58
11.61



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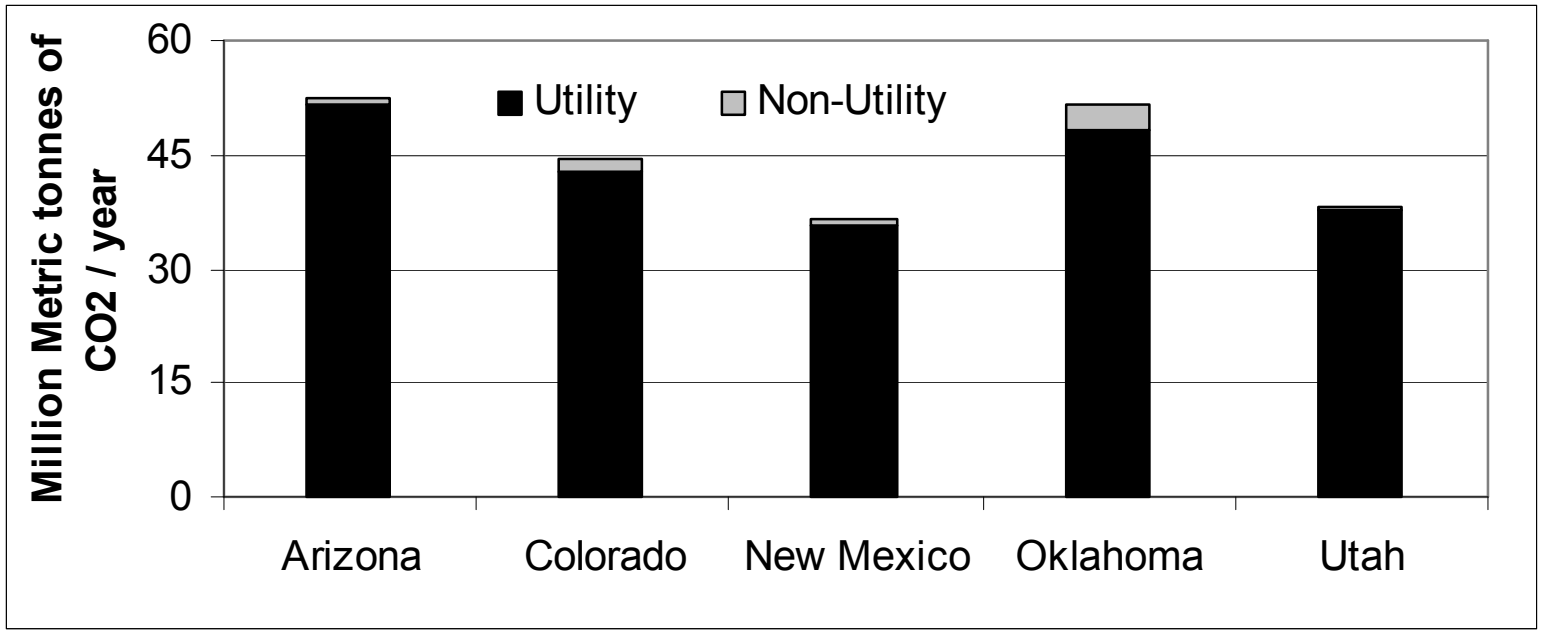
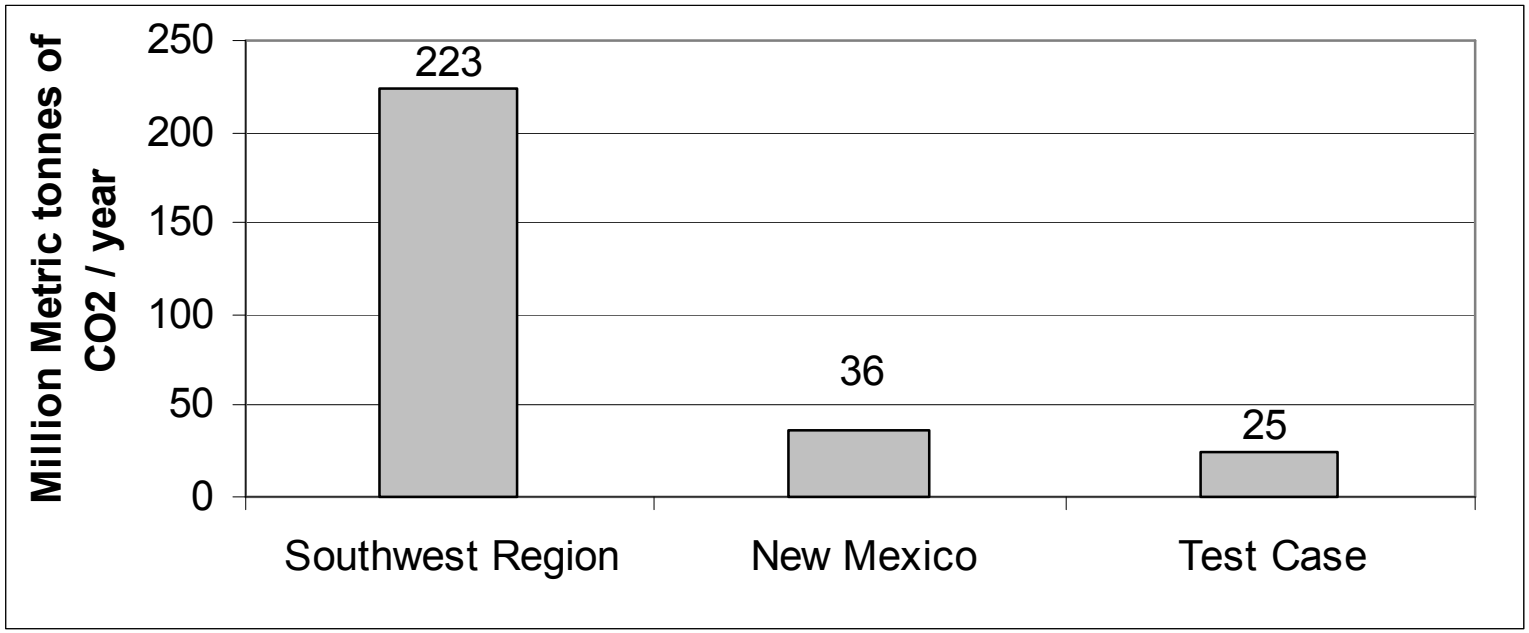
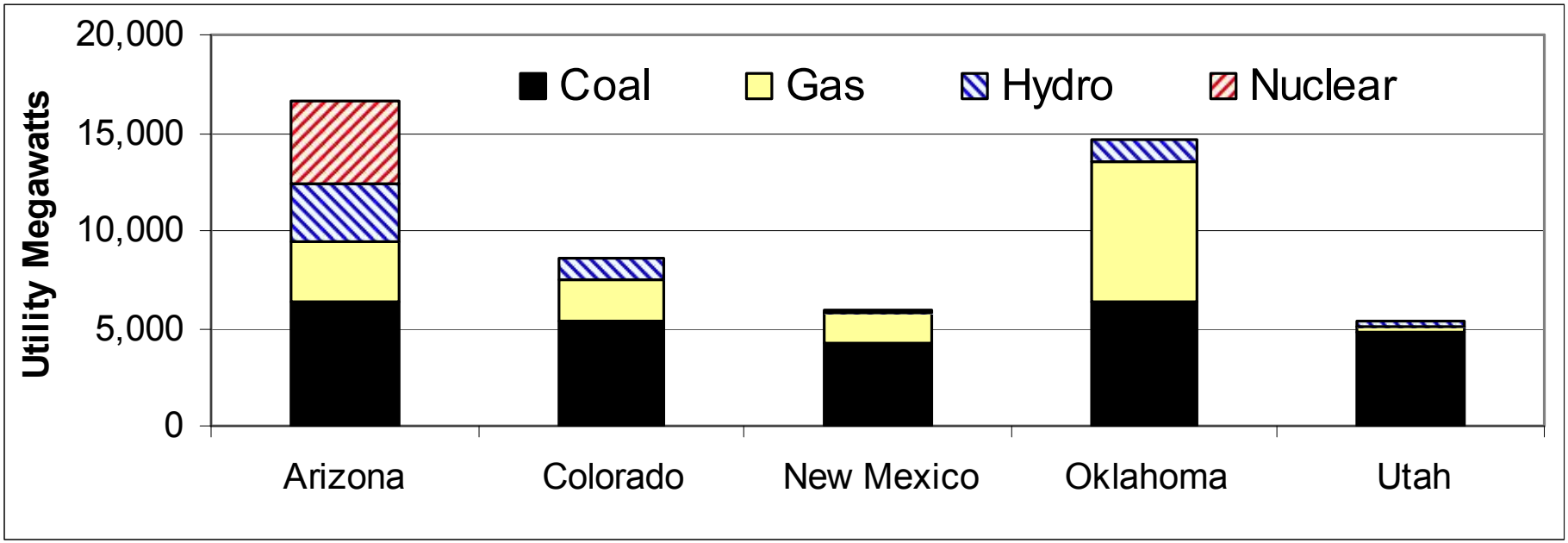
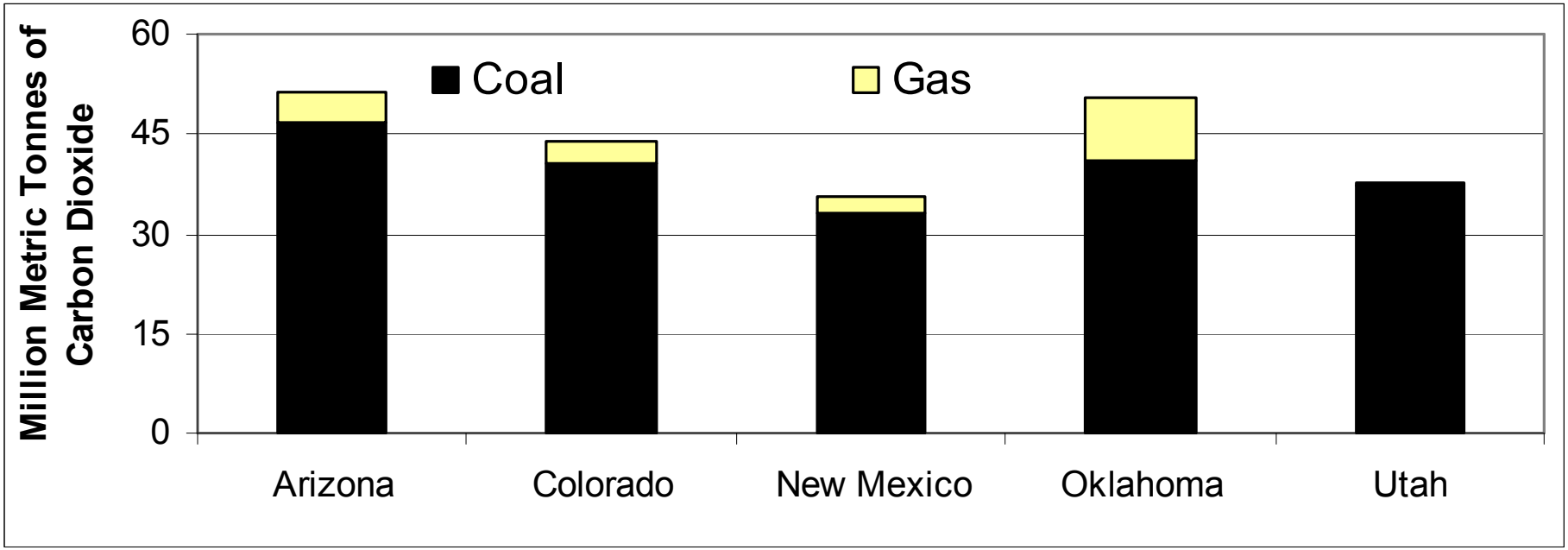

Million Metric tonnes of CO2 / year
60
45
30
15
0
Utility
Non-Utility
Arizona
Colorado
New Mexico
Oklahoma
Utah


Million Metric tonnes of CO2 / year
250
200
150
100
50
0
223
36
25
Southwest Region
New Mexico
Test Case


Utility Megawatts
20,000
15,000
10,000
5,000
0
Coal
Gas
Hydro
Nuclear
Arizona
Colorado
New Mexico
Oklahoma
Utah


Million Metric Tonnes of Carbon Dioxide
60
45
30
15
0
Coal
Gas
Arizona
Colorado
New Mexico
Oklahoma
Utah