## POINT-SOURCE LOCATIONS AND AMOUNTS OF CO<sub>2</sub> EMISSIONS ARE IMPORTANT FOR SELECTING SEQUESTRATION SITES

### KNOX OIL AND GAS FIELDS MAP SHOWING RELATIONSHIP TO POWER PLANTS WITH GREATER THAN 1,000,000 TONS OF CO<sub>2</sub> EMISSIONS



Concerns about global warming have prompted considerable research into mitigation of greenhouse gases through methods including geologic sequestration into deep subsurface units. The practice of  $CO_2$  injection for enhanced oil recovery is an attractive option because it has been used successfully for many decades in the petroleum industry, the technology already exists, and it offers a value-added sequestration method. One method of  $CO_2$  disposal would involve the capture of emissions from a coal-fired power plant, separation of the emissions to isolate the  $CO_2$  compression of the gas to a supercritical liquid, and finally dehydration of  $CO_2$  to remove any moisture in the liquid. After the gas is compressed to a liquid, it may be injected into a deep subsurface reservoir that contains adequate porosity and permeability. Dense, impermeable, confining rock units overlying the injection zone prevent migration of the injection fluid. Oil and gas fields would provide an excellent target for sequestration with a proven reservoir rock, trap, and seal (confining unit).

From the MIDCARB website (www.midcarb.org), users can access various map themes and data. Each map layer displays specific data, and individual objects can be identified and queried. The selected data can even be downloaded to the client's local computer. Here, all of the  $CO_2$  sources are displayed and a query is shown for sources that have greater than 1,000,000 tons of  $CO_2$  emissions. A 15-mile buffer was placed around selected  $CO_2$  sources on the map to illustrate the relationship of  $CO_2$  sources with the oil and gas fields. Data tables can be displayed for the selected objects. This table includes data such as the name of the facility, owner, company, fuel type, and annual  $CO_2$ emissions in tons. Total  $CO_2$  emissions for Ohio in 2002 were 99,271,211 tons.

#### ANNUAL EMISSIONS OF CO<sub>2</sub> FROM 33 MAJOR OHIO POWER PLANTS



		FACILITY NAME	ΙΔΤ	LONG	FACILITY OWNER	COMPANY NAME	CAPACITY	FUEL TYPE	CO2 TONS
		GAVIN	38 93472	-82 11584	OHIO POWER COMPANY	AMERICAN ELECTRIC POWER CO INC/PCA	2600	Coal	16 713 277
		J M STUART	38 63611	-83 69389	CINCINNATI GAS & FLECTRIC CO	DAYTON POWER & LIGHT CO/PCA	2440.8	Coal	15 055 288
		W. H. SAMMIS	40.53083	-80.63111	OHIO EDISON COMPANY	OHIO EDISON CO/PCA	2468.15	Coal	10,395,500
		W.H. ZIMMER	38.86889	-84.22861	CINCINNATI GAS & ELECTRIC CO	CINCINNATI GAS & ELECTRIC CO/PCA	1425.62	Diesel Oil	8.531.279
		CARDINAL	40.25222	-80.64861	BUCKEYE POWER, INC	AMERICAN ELECTRIC POWER CO INC/PCA	1880.46	Coal	8,206,580
		WALTER C. BECKFORD	38.99166	-84.29806	CINCINNATI GAS & ELECTRIC CO	CINCINNATI GAS & ELECTRIC CO/PCA	1432.9	Diesel Oil	6,698,382
		EASTLAKE	41.67083	-81.47916	CLEVELAND ELECTRIC ILLUM CO	CLEVELAND ELECTRIC ILLUM CO/PCA	1289	Coal	6,434,783
		MIAMI FORT STATION	39.11306	-84.80305	CINCINNATI GAS & ELECTRIC CO	CINCINNATI GAS & ELECTRIC CO/PCA	1557.25	Diesel Oil	5,267,202
		CONESVILLE PLANT	40.18417	-81.88111	COLUMBUS SOUTHERN POWER CO	AMERICAN ELECTRIC POWER CO INC/PCA	2174.9	Coal	5,019,733
		AVON LAKE	41.50417	-82.05000	CLEVELAND ELECTRIC ILLUM CO	CLEVELAND ELECTRIC ILLUM CO/PCA	884	Coal	4,752,831
		KILLEN STATION	38.69028	-83.48028	DAYTON POWER & LIGHT COMPANY	DAYTON POWER & LIGHT CO/PCA	666.45	Coal	3,726,637
		MUSKINGUM RIVER	39.59083	-81.67973	OHIO POWER COMPANY	AMERICAN ELECTRIC POWER CO INC/PCA	1529.61	Coal	2,934,063
		ASHTABULA	41.90833	-80.76667	CLEVELAND ELECTRIC ILLUM CO	CLEVELAND ELECTRIC ILLUM CO/PCA	2580	Coal	1,404,021
		BAY SHORE	41.69250	-83.43750	TOLEDO EDISON COMPANY	TOLEDO EDISON CO/PCA	2760	Coal	1,093,791
		LAKE SHORE	41.53333	-81.63750	CLEVELAND ELECTRIC ILLUM CO	CLEVELAND ELECTRIC ILLUM CO/PCA	260	Coal	909,450
		PICKAWAY	39.79333	-83.00972	COLUMBUS SOUTHERN POWER CO	AMERICAN ELECTRIC POWER CO INC/PCA	106.25	Coal	499,372
		HAMILTON MUNICIPAL	39.40694	-84.55417	HAMILTON CITY OF	CINCINNATI GAS & ELECTRIC CO/PCA	138.1	Pipeline Natural Gas	443,608
	CO2 SOURCES	WEST LORAIN	41.43333	-81.93333			2575	Pipeline Natural Gas	206,167
	INTERSTATE ROADS	WASHINGTON ENERGY	39.58194	-81.66528			944	Pipeline Natural Gas	166,642
	15-MILE BLIFFER AROUND PLANTS WITH	MADISON STATION	39.45222	-84.46500			5120	Pipeline Natural Gas	145,893
	> 1,000,000 TONS OF CO <sub>2</sub> EMISSIONS	RICHLAND PEAKING STA	41.30167	-84.46500	TOLEDO EDISON COMPANY	TOLEDO EDISON CO/PCA	1197	Pipeline Natural Gas	122,991
	PRODUCTION TYPE	WOODSDALE STATION	39.44917	-84.46500	CINCINNATI GAS & ELECTRIC CO	CINCINNATI GAS & ELECTRIC CO/PCA	489.6	Pipeline Natural Gas	121,416
0 5 10 20 30 40		EDGEWATER PLANT	41.46667	-84.46500	OHIO EDISON COMPANY	OHIO EDISON CO/PCA	260.24	Pipeline Natural Gas	110,463
	GAS	GRNVILLE ELECTRIC	40.07472	-84.46500			5952	Pipeline Natural Gas	97,399
		DARBY ELECTRIC GENER	39.70000	-84.46500			6240	Pipeline Natural Gas	96,129
	OIL	TAIT ELECTRIC GENER	39.72861	-84.46500			2912	Pipeline Natural Gas	55,166
		DAYTON POWER AND LIG	39.72805	-84.46500	DAYTON POWER & LIGHT COMPANY	DAYTON POWER & LIGHT CO/PCA	94.5	Diesel Oli Dieseling Natural Cas	32,965
	STORAGE	RUBERT P. MONE	40.92972	-84.46500			2106	Pipeline Natural Gas	19,959
			40.7 1000	-04.40300			04 22	Pipeline Natural Gas	J,141 2 520
			41.38001	-04.40500			30	Pipeline Natural Gas	2,000
		HAMILTON GENERATING	30 35522	-84 46500			30	Pipeline Natural Gas	1,440
		HAWIETON GENERATING	09.00020	-0			50	ripenne Natural Gas	1,200
		PG&F DISPERSED GEN	41 41000	-84 46500			66	Pineline Natural Gas	1 245

AVERAGE RESERVOIR CHARACTERISTICS FROM OIL AND GAS FIELDS ARE USED TO CALCULATE CO<sub>2</sub> SEQUESTRATION VOLUMES

#### CONESVILLE PLANT WITH 15-MILE BUFFER AND OIL AND GAS FIELDS



From the MIDCARB website (www.midcarb.org), users can also access oil and gas field data. For example, the Conesville coal-fired power plant is selected here and a 15mile buffer is placed around it. All oil and gas fields intersecting this buffer can be queried and displayed in a table. Reservoir characteristics associated with these fields such as depth, pressure, temperature, thickness, porosity, and acreage can be shown. These data are used to calculate the amount of  $CO_2$  that can be sequestered within the oil and gas reservoirs. Using a volumetric-based calculation, approximately 1,018,439,896 metric tons of  $CO_2$  could be sequestered within all the oil and gas fields and 349,413,376 metric tons could be sequestered in only the oil-dominant fields that intersect the 15-mile buffer for the Conesville plant. With annual  $CO_2$  emissions of 5,019,733 at the Conesville plant, there would be **69 years of sequestration potential** in the oil-dominant fields alone.

# CALCULATING CO<sub>2</sub> SEQUESTRATION VOLUMES

 $\mathbf{Q} = \rho_{\mathbf{co2}} \times \mathbf{h} \times \mathbf{a} \times \phi \times (1-\mathbf{Sw})/2200$ 

Q = Sequestration volume (metric tonnes)  $\rho_{co2} = CO_2$  density (lbs/acre-ft) h = Net thickness (feet) a = Area (acres)  $\phi$  = Porosity (percent) Sw = Water saturation (percent) 2200 (lbs) = 1 metric tonne

FLDNO PLAY		O PLAY	FIELD NAME	POOLS	DISC	DEPTH	THICK	<b>RES_TEMP</b>	<b>RES_PRESS</b>	POR	SW	RES_ACR	CO2_DEN	CO2_SEQ_VOL	PROD	
	967	KNOX	BAKERSVILLE	3	1980	7050	10	130	2200	0.15	20	19,977	1,805,998	19,679,135	GAS	
	948	KNOX	BALTIC	12	1965	6390	40	130	2500	0.10	20	100,505	1,938,856	283,439,538	GAS	
	391	KNOX	BLOOMFIELD	7	1991	6485	10	110	2200	0.15	50	11,246	2,062,130	7,905,927	GAS	
	1322	CLNN	DAVIS HOLLOW	2		1841	18	70	600	0.08	50	1113	275,735	100,438	GAS	
	1035	CLNN	DRESDEN CONSOLIDATED	9	1917	3387	42	80	900	0.10	50	45,024	542,758	78,571,950	GAS	
	1390	KNOX	FRAZEYBURG	6	1989	5825	30	100	2000	0.08	30	16,901	2,113,967	27,283,317	GAS	
	1049	CLNN	NAVARRE	244	1946	4203	15	100	1400	0.07	25	396,810	1,763,309	250,460,282	GAS	
	1003	CLNN	WEST BEDFORD	1	1965	3302	19	90	900	0.11	50	3898	480,467	889,608	GAS	
	584	CLNN	ZANESVILLE	3	1928	3580	18	100	1100	0.08	28	2136	691,733	696,325	GAS	
	1019	CLNN	GRATIOT-NEWCASTLE	30	1924	3000	18	90	1000	0.10	30	177,216	622,037	185,557,125	OIL	
	1004	CLNN	MONROE-COSHOCTON CONS	S 33	1917	3338	12	100	1600	0.06	40	117,511	1,939,291	44,748,926	OIL	





