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Clean Coal Technology Synthesis Report: A State Perspective

NARUC

The National Association of Regulatory Utility Commissioners

DOE/NARUC Partnership for Advanced Clean Coal Technology

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1.0 Introduction

The demand for electricity in the United States continues to grow while a major portion of the existing generating capacity will be due for renewal or upgrade in the near future, due to aging and/or environmental regulations. In the meantime public perception of various conventional technologies used for power generation has changed, primarily due to their adverse environmental impacts. At the moment gas turbine combined cycle (GTCC) power plants are most popular because of their low installation costs, short lead time, high energy conversion efficiencies, and lower operating costs aided by low gas prices. Most new capacity installed now is GTCC because gas prices have remained more or less stable for more than a decade. However, given that gas reserves are much smaller than that of coal and that gas has a multitude of other more productive uses than burning for power generation, alternative technologies must be pursued in order to meet future needs (10-15 years from now).

Clean coal technologies (CCT) are seen as a way in the near term future to enable cleaner burning of coal in conventional steam turbine plants using either new combustion technologies and pollution control devices, or to substitute coal derived gases for natural gas in gas turbines. Most of these technologies have been demonstrated on utility scale plants but, in the absence of economies of scale, they are more expensive than comparable conventional alternatives. Additionally, public perception of coal as a dirty fuel and the utility industry's inclination to avoid any additional costs until absolutely necessary, due in part to the uncertainties in a deregulated market environment, discourage CCT implementation. Without commercial utility operation the cost and environmental performance of CCT might not improve. These technologies need to be available to be phased in as efficient substitutes as and when gas prices rise. Otherwise, there will be high electricity prices while coal reserves remain unused. From a national economic perspective, it is imperative that efforts be made to educate the public and encourage the utilities to begin adopting CCT, even as a small portion of their overall portfolio.

The Partnership for Advanced Clean Coal Technology (PACCT) outreach project initiated by NARUC (the National Association of Regulatory Utility Commissioners), with the Department of Energy (DOE) as sponsor, aims at involving the State utility regulators, among other key players, in the CCT diffusion effort. DOE recognizes the crucial role the regulators play in the functioning of local electricity markets and that regulators' perspectives on State energy issues are essential for correctly identifying the most prospective CCT deployment opportunities as well as the ways in which any barriers to their deployment can be addressed.

To focus future efforts on those States and regions that have the most potential for CCT implementation, NARUC provided an outline survey to utility commissioners. The

survey was primarily meant for project scope formulation. This report summarizes the results of this survey primarily along two dimensions, facts and informed assessment of future possibilities. The report identifies some barriers and opportunities, as far as practicable, from an aggregation of survey responses.

2.0 Scope

This report is entirely based on the responses to the NARUC survey of commission staff from 32 States, and the generation statistics for the years 1999 and 2000 available from the Energy Information Administration's (EIA) website (http://www.eia.doe.gov/cneaf/electricity/epav1/ta8p1.html).

2.1 The survey

The original survey (appendix 1) consisted of five parts:

- Background information
  - total and coal based generation capacities, any existing or proposed pollution control technologies,
  - any experience with the two categories of CCT--environmental control devices (hereinafter referred to as control technologies), and
  - power generation systems (hereinafter referred to as generation technologies), and the scope of the regulatory commission's role

- CCT development opportunities
  - possible regulatory intervention conducive to CCT diffusion

- Barriers to CCT deployment
  - barriers to the deployment of generation technologies,
  - barriers to retrofitting existing plant with control or generation technologies,
  - regulatory actions that might reduce the barriers

- Potential for rapid CCT deployment in terms of
  - existing infrastructure and access to coal,
  - future capacity expansion/renewal plans, and
  - prior experience with CCT demonstration

- Assessment of public attitude toward CCT in terms of
  - public reaction to any recently proposed coal fired power plant, and
  - the likely reaction to a would-be CCT plant proposal.

2.2 The Report

The scope of this report includes

- compilation of the survey responses;
- their aggregation using codes;
- ranking of States in terms of their CCT potential based on these codes;
- inferences drawn from the aggregations;
- conclusions on who the likely candidates might be for inclusion in the next phase of PACCT, and the unresolved issues that need to be addressed in making a final selection of these candidates as well as the expected contribution from each selected candidates in order for the next phase to achieve its objectives
- recommendations on the scope of and approach to PACCT phase 2.

3.0 Methodology

The survey responses have been entered in a database, question by question, and State by State. Appendices with detailed data on specific plant descriptions haven't been entered but their summaries, where important, have been included in the answer to the relevant question(s).

3.1 Data Transformation

The survey responses, for the most part, consist of descriptive data that needed to be coded to make them comparable. The basic characteristics of the coding scheme were as follows:

- For capacity related data, the numerical data were divided up in ranges and each range was assigned a numerical index, with the higher value of the index signifying larger capacity. (The capacity figures were approximated from the annual generation figures for each sector/State using a capacity factor of 75%. This assessment is believed to be conservative and not likely to overstate the installed capacities.)

- For data relating to usage of, or exposure to, different technologies, separate letter codes were assigned to each individual or groups of technologies consistent with the objective of data analysis. Additional comments that aid in analysis were retained (using cross references) when a specific response was coded.

- For data relating to jurisdiction, several classes were created for the varying scope of regulatory authority, with each class identified by a code. Where numerical codes have been used, they are not to be interpreted as signifying any order.

Additional comments that aid in analysis were retained (using cross references) when a specific response was coded.

- For data relating to barriers, each type of barrier was assigned a code. Additional comments that aid in analysis were retained (using cross references) when a specific response was coded.

- For data relating to possible CCT diffusion enhancing actions, the actions were classified by their nature (e.g., economic incentive, market means, etc.), with each classification assigned letter code. Additional comments that aid in analysis were retained (using cross references) when a specific response was coded.

- For data relating to subjective assessment of likelihood, primarily three categories have been used: yes, no, and uncertain. To allow the reader of this report to make his/her own conclusions, letter codes signifying the basis upon which the assessment rests have been added where such data were made available by the respondents. Cross references to additional comments are also included where considered useful.

3.2 Analysis

For the purpose of analysis, the coded survey responses have been grouped by questions; e.g., all questions relating to the commissioners' regulatory roles and opportunities have been brought under single class. The participating States have been compared against each other group by group. The overall ranking in terms of CCT prospects, although no rank order has been assigned, included a qualitative multivariate analysis based on their rank in each group. Additional information on the methods used has been included in the corresponding sections/subsections of this report.

4.0 Tabulation of Survey responses

The original responses of the participants are contained in Appendix 2 (not included in the draft report), grouped by mutually related questions. The groupings used are as follows:

Q1-2: answers to questions 1 & 2, Part 1

Q3-4-5: answers to questions 3, 4 & 5 , Part 1

Q6-7-8-9: answers to questions 6, 7, 8 & 9, Part 1

Q10-11: answers to question 10, Part 1, and question 1, Part 2

Q12-13-14: answers to questions 1, 2 & 3, Part 3

Q15-16-17: answers to questions 1, 2 & 3, Part 4

Q18-19: answers to questions 1 & 2, Part 3

5.0 Coding and analysis

The tabulations with codes use the same group and corresponding question identifiers as given in the previous section.

5.1 Capacity (Q1-2)

The data for capacity were taken from EIA generation statistics and the respondents' figures have not been used, the former being more comprehensive. The coded data are contained in Table Q1-2, with the rules and transformations used in the footnote to the table.

As evident from the table any State having a score of 3, 4, or 5 in either the "Capacity code by MW" or "Capacity code as % of total" should have CCT deployment potential. The former of the two indicates the size of installed coal fired capacity while the latter indicates their degree of dependence on coal for electricity generation. Accordingly, States with the codes 3, 4, and 5 are considered prospective when judged by their dependence on coal.

The data have also been coded by utility and nonutility sector to identify any CCT potential in the nonutility sector over which the utility regulators often do not have

jurisdiction. It would appear that the nonutility sector in both Pennsylvania and Illinois are major users of coal, while in New York coal fired generation from the nonutility sector exceeds that of the utility sector.

5.2 Usage of Control technologies (Q3-4-5)

The coded data are contained in Table Q3-4-5, with the rules and complementary comments in the footnote to the table.

The codes fall into three categories reflecting on the approach taken to reduce the adverse environmental impacts of coal fired generation: avoidance, passive and active. The avoidance approach entails retirement/repowering or reduced usage of plant, combustion monitoring and fuel switching. The passive approach entails trading of emissions credits and increased monitoring, although a monitoring technology such as Neural Net may be considered a part of the DOE's CCT program. The active approach entails usage of the control technologies that are of interest here.

The data indicate that scrubbers, low-Nox burners, and selective NOx reduction are the most commonly used technologies, with overfire air attracting some interest. However, many of the technologies listed under different States were demonstration projects. It would appear that the principal driving force behind control technologies adoption might be the environmental standards that apply to a given plant. Hence ranking the States based on their exposure to different control technologies in identifying the State's potential may be misleading. Nevertheless, a higher number of different technologies implemented/tried out by utilities in a given State indicates an active interest in these technologies; driven by environmental regulations or otherwise.

5.3 Usage of generation technologies (Q6-7-8-9)

The coded data are contained in Table Q6-7-8-9, with the rules and complementary comments in the footnote to the table.

Most of the projects included in the table are demonstration projects. In general, it would appear that there is a greater interest in fluidized bed combustion (FBC), possibly as a retrofit. A few integrated gasification combined cycle (IGCC) projects are being demonstrated. As for control technologies, here too implementation (and/or firm proposal to implement) CCT generation technologies does indicate a greater interest in CCT. Those States with more than one project (including firmly proposed) have been highlighted in the table.

5.4 Commissions' roles in and opportunities for CCT deployment (Q10-11)

The coded data are contained in Table Q10-11, with the rules and complementary comments in the footnote to the table.

As for the commissions' jurisdiction (column 10-1), it would appear that some degree of jurisdiction over a CCT facility could allow the utility commissions to facilitate CCT deployment. Jurisdiction provides the regulators with the greater ability to influence the decision process. Thus the States where such jurisdictions exist have been flagged in table Q10-11. A CCT facility is expected to be a major facility and therefore, States where the commissions have jurisdiction only over major facilities have been included. States identified with letter code "B" should be interpreted with caution, as their jurisdiction may not extend beyond Investor Owned Utilities (IOU).

Some State commissions also have some control over the siting of power plants (column 10-2). Here again the greater the involvement of the regulators, the higher is their likely influence. However, such regulatory control may, in certain circumstances, impede introduction of technologies that can not be economically justified, or be unable to provide reliability guarantees. Any interpretation of the codes should take into account the specifics of a proposed project. In this report, therefore, no attempts have been made to rank States based on this aspect.

As for CCT deployment opportunities in terms of financial incentives (column 11), any letter code indicates some opportunities. The letter codes representing direct or indirect funding are certainly more preferable. In general, more letter codes in a State response indicates more opportunities for CCT deployment in that State when judged by this parameter. The States that offer substantial incentives have been flagged.

5.5 Barriers to CCT deployment & how to reduce them (Q12-13-14)

The coded data are contained in Table Q12-13-14, with the rules and complementary comments in the footnote to the table.

A number of barriers to CCT implementation have been identified by the respondents (column 12). Q12 of the survey was interpreted by the respondents as applying to greenfield CCT generation technologies. The lack of cost-competitiveness of CCT (compared to GTCC) appears to be the biggest concern, closely followed by stringent environmental regulations governing coal handling and use, and public/political opposition or lack of support. The respondents are also concerned about new technology risks, both technical performance and market risks, that are considered significant impediments to attracting project financing. In general, States with a letter code "A" would appear to be the least likely candidates for CCT implementation while the States with a letter code "N" are the most likely, if the cost performance of a plant is made

comparable to a GTCC plant, through funding, subsidies, etc. The environmental performance of CCT is worse than that of GTCC and therefore, the States with tough standards would discourage CCT implementation.

In terms of barriers to retrofitting existing plants with CCT (column 13), the cost factor again dominates. There is also significant concern about future environmental regulations and their impact on the retrofitted plants, given a general public/political opposition to anything that includes the word "coal." This uncertainty discourages any new investment, given additionally switching to, or cofiring with, other cheap cleaner fuels appears to be a cost-effective alternative. The age of most existing coal fired plants appear to cause concern as to the worth of their retrofitting, while the major newer plants either have some pollution control technologies already or are operating on cheaper cleaner fuels. In terms of retrofit opportunities, it would appear that relatively newer plants hold some potential, if they are unable to meet the environmental regulations even after combustion optimization, fuel switching and other market means. As some respondents identified, the cost of retrofitting an old plant may exceed the cost of a new GTCC and the latter may be installed quicker than the former.

On the reduction of the regulatory barriers (column 14), an overwhelming number of respondents could not offer any suggestions, possibly because the cost factor appears to dominate all others in the deregulated market. This is also supported by a large number suggesting governmental actions to provide financial incentives, guarantee cost recovery and require the utilities to include CCT in their portfolio, as well as regulatory actions such as accelerated permitting and preferential ratemaking for CCT. The need for a campaign to improve coal's image, by educating the public on the differences between CCT and conventional coal fired generation, has also been highlighted.

5.6 CCT adoption potential (Q15-16-17)

The coded data are contained in Table Q15-16-17, with the rules and complementary comments in the footnote to the table.

In terms of existing electricity infrastructure (column Q15), most respondents consider their States suitable for CCT deployment, although in some cases transmission constraints and public opposition to coal usage will have to be overcome. Most consider that CCT would take off in their States as soon as they become cost-effective. States that have prior experience with CCT plants, and depend heavily on coal for power generation are considered to have an environment conducive to CCT deployment, and have been identified with a letter code "F." An additional code "I" has been used for States where the governments encourage coal usage by means of incentives.

Any future plans to implement CCT by States have also been included (column 16) to indicate their interest. As an indicator of experience with CCT the types of generation technologies demonstrated or firmly proposed are shown in column 17.

5.7 Public acceptance of CCT (Q18-19)

The coded data are contained in Table Q18-19, with the rules and complementary comments in the footnote to the table.

Although the past is not always a good predictor of the future, it is useful in assessing societal trends. An assessment of public reaction to any coal fired power plant proposed during the last decade was sought from the State regulators for their respective States. The responses indicate (column 18) that there have been very few such proposals, or in the deregulated market the regulators do not have access to such information until a developer submits a proposal. It is clear, however, from the very few responses from States that dealt with such proposals, that public concern had been a significant issue that resulted in the demise of some proposals. So in general, the public does not appear to be favorably disposed toward coal.

The respondents were also asked to project the likely public reaction to a CCT proposal in their respective States (column 19), presumably based upon their experience (such as prior proposals, types of objections and complaints they receive, etc.). In general, the public in States identified as favorable for CCT adoption (refer column Q15, Table Q15-16-17) would appear more likely to view such proposals favorably. There is an indication that the public will be more willing to accept CCT in most States (that participated in the survey) as and when gas fired generation becomes less economical.

6.0 Aggregation

Based upon the analysis presented in the previous section, the following criteria may be applied to identify the most likely candidates for CCT deployment:

1. Size of coal based generation capacity (the larger, the better, either sector)
2. Dependence on coal for electricity generation (the greater, the better)
3. Usage of active control technologies (the greater the use or potential use, the better)
4. Implementation of CCT generation technology (the more projects firmly proposed or built since the first demonstration project, the better)
5. Regulatory jurisdiction (the more expansive, the better)
6. Incentives (the more diverse and higher the incentives, the better)
7. Barriers to greenfield CCT (the lower, the better)
8. Barriers to Retrofit (the more practical and economically sensible, the better)
9. Regulatory initiatives to lower the barriers (the more flexible the current and firmly planned implementation practices and procedures, the better)

10. Prior experience with CCT as well as those firmly proposed for the near future, considered in conjunction with (1) (the greater the number and diversity of CCT tried or proposed, the better, provided their dependence on coal is high)
11. Public attitude toward coal considered in conjunction with (1) and (6) (the more neutral, the better)

Table 1 contains the results of this assessment. States with high potential are highlighted and grouped by rank priority. However, given the variability of the data, these rankings should not be the sole basis for judging which States should be selected as candidates for the CCT diffusion effort. Discretion and judgment by the decision maker might cause other States to be included in the CCT diffusion effort.

7.0 Conclusion

It is imperative that CCT remain a part of the available generation mix. Even though natural gas prices have remained more-or-less stable during the past decade, the heavy reliance on natural gas-fired generation for new generation will significantly increase demand and may ultimately increase price. CCT provides a much needed hedge against over-reliance on electricity from one fuel source.

In order to continue to pursue CCT as a viable alternative to gas-fired generation, efforts must be made to educate the public about CCT and to encourage utilities to adopt CCT as part of their overall portfolio. Utilities are most likely to pursue CCT in States with large coal based generation capacity, particularly where there is heavy reliance on coal for electricity generation. CCT is likely to be better accepted where there is already usage of active CCT. And, there is likely to be a better reception for CCT where there has already CCT implemented.

Based on the aggregation factors above, efforts at CCT diffusion pursued by the PACCT outreach project would include some or all of the following States:

1. Pennsylvania, Illinois, Indiana, Ohio, West Virginia, Kentucky, Texas;
2. Michigan, Florida, Georgia, North Carolina, Alabama; and
3. Wisconsin, Missouri, and Tennessee.

Please note that there was no survey response from a several States that are heavily reliant on coal capacity for their generation. These States include Arizona, Colorado, Montana, Nevada, Oklahoma, and Wyoming. No judgment is made here as to their likely suitability to be added to the list of States where CCT diffusion should be pursued. Nor does the exclusion of any other State from the above list necessarily imply that CCT diffusion should not be pursued in those States.

One of the significant gaps in the data resulted from very limited involvement of major generation companies and utilities that are the most important players in any generation technology diffusion. The long-term resource plans of the utilities, if made available and incorporated in the survey responses, might have made this study more comprehensive.

8.0 Recommendations

The recommendation is for the Partnership for Advanced Clean Coal Technology (PACCT) outreach project to begin to identify and to contact State regulators from the State public utility commission, the State environmental protection agency, the State siting commission (if separate), and the State economic development commission for a selected group of States identified as candidates for the CCT diffusion effort, and to form a coordination committee. In addition,

- PACCT should collaborate with the privately-owned utilities, any publicly-owned utilities, and any independent power producers in each State, particularly those that are actively involved in coal based generation and operate in multiple States.

- Any coal mining and coal mining labor interests within each State as well as CCT vendors should be involved, in order to better establish how CCT is likely to evolve in terms of projected cost and performance in the medium term future, and the regulatory mechanisms necessary for CCT to realize its potential.

- Public interest groups should also be invited, including environmental groups within each State and the local media should be kept up to date on the initiative.

- Educational interests, including primary, secondary, and high education, should be contacted.

Then, the PACCT can begin the second phase of its endeavor to encourage CCT diffusion in selected candidate States.

Appendix 1: Survey Questionnaire (Renumbered)

Background Information

1. What is the total electric generation capacity in your state?

2. In your state, what percentage of total generation capacity is from coal-fired generation

3. Which *Sulphur-Dioxide Control Technologies* have been deployed or proposed in your state since 1992? Please list location.

4. Which *NO x Control Technologies* have been deployed or proposed in your state since 1992? Please list location.

5. Which *Combined SO 2 - NO x Technologies* have been deployed or proposed in your state since 1992? Please list location.

6. Do you have *Fluidized Bed Combustion* generation units in your state? Please list.

7. Have any *Fluidized Bed Combustion* generation units been proposed in your State since 1992? Please list.

8. Do you have *Integrated Gasification Combined Cycle* generation units in your state? Please list.

9. Have any *Integrated Gasification Combined Cycle* generation units been proposed in your State since 1992? Please list

10. What is the role of your commission in siting new generation facilities?

Opportunities within State or region for the further development of clean coal technologies

11. In the context of tax incentives, preferred ratemaking treatment, technology support, or technology funds - where do opportunities exist for the accelerated deployment of clean coal technology in your State.

Barriers within States or region that hinder the deployment of clean coal technologies

12. List and describe two main barriers to the deployment of new clean coal generation technology in your State (e.g. weak public support, excessive cost, weak legislative support).

13. List and describe the two main barriers to the deployment of retrofitted clean coal generation technology in your State

14. List three regulatory actions you, as a State utility commissioner, can consider in your state to reduce barriers to the deployment of clean coal technologies.

States with the greatest potential for rapid clean coal technology deployment *in terms of existing infrastructure*

15. In terms of the existing electricity infrastructure (including access to coal), would it be reasonable to site a clean coal demonstration project in your state within the next five years? Explain answer

16. In your state, are there any clean coal projects planned to go online within the next 10 years? If so, please indicate when, where, and number of MWs.

17. List current clean coal demonstration projects in your State

States with the greatest potential for the rapid deployment clean coal technology *in terms of public acceptability*

18. Have any coal-fired plants been planned, but unable to be sited in your state since 1992? If so, please indicate when, where, and number of MWs.

19. In your opinion, would there be adequate public support to site a coal-fired generation unit -using clean coal technology - in your state within the next 5 years?

Q 1-2

Coal fired generation by state

Census Division and State	MW equiv using 75% cap factor			Cap Code*			Coal based as % of tot generation	Cap code of State by % coal generation	From all sources (not just coal) Total generation Million kWh	
	Utility	Nonutility	state	Utility	Nonutility	State as a whole			2000	1999
New England	**770**	**2370**							112,829	111,634
Connecticut	0	604	604	0	0	**0**	12%	**0**	33,478	28,830
Maine	0	159	159	0	0	**0**	8%	**0**	13,050	12,958
Massachusetts	167	1608	1774	0	1	**1**	28%	**2**	39,148	41,519
New Hampshire	604	0	604	0	0	**0**	24%	**1**	14,944	16,206
Rhode Island									5,926	6,411
Vermont									6,282	5,709
Middle Atlantic	**15665**	**16641**							401,746	397,283
New Jersey	972	726	1698	0	0	**1**	17%	**1**	58,204	56,995
New York	1667	3119	4786	1	2	**2**	17%	**1**	138,039	144,643
Pennsylvania	13026	12796	25822	4	4	**5**	59%	**3**	205,502	195,645
East North Central	**62271**	**9114**							617,265	589,446
Illinois	9881	7773	17654	3	3	**5**	46%	**3**	177,404	163,601
Indiana	17903	502	18405	5	0	**5**	94%	**5**	127,970	121,594
Michigan	10520	214	10734	4	0	**4**	68%	**4**	104,222	103,350
Ohio	19212	504	19717	5	0	**5**	87%	**5**	148,438	142,401
Wisconsin	6250	192	6442	3	0	**3**	71%	**4**	59,230	58,500
West North Central	**32233**	**542**							284,512	275,382
Iowa	5153	187	5340	2	0	**2**	84%	**5**	41,519	38,842
Kansas	4948	0	4948	2	0	**2**	73%	**4**	44,834	42,070
Minnesota	4830	305	5135	2	0	**2**	66%	**4**	51,429	48,607
Missouri	9532	45	9577	3	0	**3**	82%	**5**	76,626	73,827
Nebraska	2804	7	2811	1	0	**1**	61%	**4**	29,122	30,057
North Dakota	4407	13	4420	2	0	**2**	92%	**5**	31,284	31,421
South Dakota	559	0	559	0	0	**0**	35%	**2**	9,697	10,557
South Atlantic	**61375**	**4209**							754,785	740,313
Delaware	505	115	621	0	0	**0**	59%	**3**	5,912	6,877
District of Columbia									142	230
Florida	10220	781	11001	4	0	**4**	38%	**2**	190,936	186,928
Georgia	12026	229	12255	4	0	**4**	65%	**4**	123,067	117,681
Maryland	4468	1220	5688	2		**2**	57%	**3**	50,204	51,733
North Carolina	10917	698	11614	4	0	**4**	62%	**4**	122,114	117,588
South Carolina	5885	100	5985	2	0	**2**	42%	**3**	92,614	90,330
Virginia	5170	861	6031	2	0	**3**	51%	**3**	77,013	74,165

West Virginia	13874	344	14218	4	0	4	99%	5	92,783	94,781
East South Central	35021	2094							350,619	342,307
Alabama	11710	83	11793	5	0	4	62%	4	124,554	120,865
Kentucky	11963	1734	13698	4	1	4	97%	5	92,630	93,108
Mississippi	2112	1	2113	1	0	1	37%	2	37,516	34,915
Tennessee	9235	276	9512	3	0	3	65%	4	95,918	93,419
West South Central	32640	2135							569,110	551,181
Arkansas	3746	9	3755	2	0	2	53%	3	43,975	46,622
Louisiana	3222	1307	4528	2	1	2	26%	2	89,938	90,096
Oklahoma	5000	495	5495	2	0	2	64%	4	55,441	55,016
Texas	21016	437	21454	5	0	5	37%	2	379,756	359,448
Mountain	31568	2615							325,013	315,255
Arizona	6189	53	6242	3	0	3	46%	3	89,101	84,012
Colorado	5343	43	5386	2	0	2	81%	5	43,661	39,530
Idaho	0	9	9	0	0	0	0%	0	11,967	14,404
Montana	2433	2409	4841	1		2	54%	3	28,803	31,483
Nevada	2882	342	3224	1	0	2	54%	3	35,639	32,800
New Mexico	4424	0	4424	2	0	2	86%	5	33,994	32,581
Utah	5194	87	5281	2	0	2	94%	5	36,590	36,812
Wyoming	6599	36	6635	3	0	3	96%	5	45,257	43,632
Pacific Contiguous	1880	1332							367,273	365,428
California	0	376	376	0	0	0	1%	0	207,047	191,584
Oregon	576	4	580	0	0	0	7%	0	51,415	56,708
Washington	1318	952	2269	1	0	1	8%	0	108,811	117,135
Pacific Noncontiguous	28	305							16,792	16,314
Alaska	28	57	85	0	0	0	9%	0	6,140	5,812
Hawaii	0	247	247	0	0	0	15%	0	10,652	10,503
U.S. Total	269053	41264							3,799,944	3,704,544

utility nonutility state * Installed Capacity code, by MW

state ** Installed coal fired capacity code, as % of total generation capacity

10^6 kWh to MW capacity conversion factor @ 75% capacity factor:	152

The above values derived based on the higher of the figures for 1999 and 2000 (because the nonutility figures for 2000 are preliminary)

Cap code- capacity based coding is done as follows:
0 for <=1000 MW
1 for 1000<MW<=3000
2 for 3000<MW<=6000
3 for 6000<MW<=10000
4 for 10000<MW<=15000

Cap coding of coal based plant as % of total generation capacity:

0 - <=15%
1 - 16-25%
2- 26-40%
3- 41-60%
4- 61-75%
5- >75%

Q3-4-5

Control Technologies used

Q6-7-8-9

Generation technologies used

Census Division and State	Q3-5: Control Technologies				Q6-9: Generation Technologies		
	SOx **Q3**	NOx **Q4**	SOx-NOx **Q5**	# of tech used	FBC **Q6-Q7**	IGCC **Q8-Q9**	
New England							
New Hampshire	F	ACNR		3			
Middle Atlantic							
New York	S	NR	D	4			
Pennsylvania	SL	ACNR	D	4	E	C	
East North Central							
Illinois	S	NR		3	E	P	2
Indiana	IDL			3	CP	E	2
Michigan		ANR		3			
Ohio	F	NR		2			
Wisconsin	F	NR*		2	C	P	
West North Central							
Iowa	F	CN		2	I		
Kansas	F				C		
Minnesota	F	A		1	EP*	P	3
Missouri	S	NR		3			
Nebraska		N		1	E		
North Dakota	S	AN		3	E		
South Dakota	F	M					
South Atlantic							
District of Columbia							
Florida	S	NR*		3	EP	E	3
Georgia	FST	ANR		4		EP	2
North Carolina		R		1			
South Carolina	SL	AMNR		5			
Virginia	FLS	CNR	D	4	EP	P*	3
West Virginia	FS	ANR		4	E		
East South Central							
Alabama	FS	NR		3			
Kentucky	L	NR		3	P		
Mississippi	*	*			E		
Tennessee						*	

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West South Central						
Arkansas						
Texas					E	
Mountain						
New Mexico						
Utah	S	N		**2**	E	C
Pacific Contiguous						
Oregon		R*		**1**		
Washington	L			**1**	E	
Pacific Noncontiguous						
Alaska	S	N		**2**	N	

Coding rules for 3-5:

Avoidance approach

F: switching to low sulphur coal/oil, coal washing
C: combustion optimization (phased coal injection, staged combustion with low excess air, etc.)
0: retirement/repowering

Passive approach

M: monitoring (Including Neural Net and the like)
T: trading of emissions allowance

Active prevention or mitigation (Technology)

A = Close coupled (CCOFA) or separated overfire air (SOFA), FAN
N = Low NOx burners (LNB) or concentric firing system (LNCFS)
R = Selective reduction, catalytic (SCR) or non-catalytic (SNCR)
S = Scrubbers (dry or wet FGD, spray drier absorbers)
L = sorbent injection with(out) multistage burners (NH3, LIFAC, LIMB)
I = Granular coal injection
D = Various advanced Sox-NOx control system demos: AES, WSA-SNOX, SNRB, NOXSO, ECO, etc.
Blank= None or No information
*= See note below

*Florida- Other unspecified NOx control technologies also used
*Oregon- not known if the technology is employed at coal fired plants
*Wisconsin- both technologies are firmly proposed for installation
*Mississippi- Only four plants are required by law to install control technologies (type not specified)

Coding rules for Q6-9:

E- Exist(ed) or under construction
P- More Proposed
N- Proposed but not actively pursued
C- Proposed but cancelled/withdrawn
I- Seriously interested
Blank- None or no information
*- See notes below

*Minnesota- CC replaced an old FBC
*Tennessee- Answers yes to IGCCs, but possibly confusing with GTCC
*Virginia- An existing CC plant is permitted for IGCC, but never converted

CC- stands for GT combined cycle

Q 10-11:
Commissions' roles in & opportunities for CCT deployment

Census Division and State	Q. 10-1	Q. 10-2	Q. 11
New England			
New Hampshire	K		C
Middle Atlantic			
New York	G		FT
Pennsylvania	L	25	F*
East North Central			
Illinois	B		?
Indiana	A		**F
Michigan	L		EFST
Ohio	H		F
Wisconsin	C	?	
West North Central			
Iowa			
Kansas	D		T
Minnesota	C		
Missouri	F		
Nebraska	A*		HS
North Dakota	A*		DF
South Dakota	A	2	FST
South Atlantic			
District of Columbia			
Florida	CI	12	FJT
Georgia	L		
North Carolina	A*	25	
South Carolina	CE	12345*	*
Virginia	A	1	FT*

Coding rules for Q10:

The answers to question 10 break down into two categories.
The first category (10-1) deals with jurisdiction and is more complex
The second category (10-2) deals with what is necessary to obtain siting.
In each category, more than one code may apply to a state

10-1 Coding for jurisdiction:

Blank= No information

A = Jurisdiction;

B = Jurisdiction Over IOU, but not over IPP, EWG, or Non-Utility;

C = Siting Over Major Facility or Some Level of MW Only;

D = Siting Over Nuclear Only;

E = Siting Over Non-hydro;

F = Siting Only for IOUs Constructing Outside Their Service Area;
Siting Board or Power Review;

G = Commission Predominates Power Siting Board of Power Review Board;

H = Siting Board with Commission Involvement;

I = Independent Siting Board (check appendix in master copy);

J = Environmental Agency Leads;

K = Other Agencies;

L = No jurisdiction.

* = Limited or Extended Jurisdiction (see note for each case below)

Q10-1 Footnotes:

*NE (10-1) Nebraska Power Board

*NC (10-1) except self-generation

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West Virginia	A	1	E
East South Central			
Alabama	B		EF*
Kentucky	AB		D
Mississippi	A		
Tennessee	I		CFT*
West South Central			
Arkansas	BC	12	F
Texas	AL*		S*
Mountain			
New Mexico	C		*
Utah	B	1	
Pacific Contiguous			
Oregon	I		
Washington	CH		
Pacific Noncontiguous			
Alaska	L		FS

*TX (10-1) L in ERCOT areas, A in non-ERCOT areas

10-2 Coding for what is necessary for siting

Blank= No information
1 = Certificate or Finding of Convenience and Necessity Required;
2 = Certificate for Finding of Environmental Compatibility Required;
3 = System Reliability Effects Considered;
4 = Economics and feasibility considered;
5 = Compliance with local zoning is required.
* = Limited or Extended authority (see note for each case below)

Q10-2 Footnotes:
*SC (10-2) Commission can preempt local laws, regulations, or zoning.

Coding rules for Q11:

More than one code may apply to a state

Blank= Slim to none or No information
C. Market-Based Emission Allowance Trading
E. Preferred Ratemaking Treatment
F. Funding support for Project/R&D (Govt. or other)
J. Streamlined Environmental Review for Retrofit/Upgrade Projects
S. Technology Support
T. Tax Incentives (Federal or State)
* See special note
** Under consideration

Q11 Footnotes:
*AL (11)- by TVA
*IN (11)- under consideration, particularly F
*NM (11)- State incentives are available
*PA (11)- tax-exempt financing
*SC (11)- L, but keenly interested
*TN (11) - with tradable tax component
*TX (11) - particularly to retrofit existing coal plants
*VA (11) - particularly through the fuel clause to allow cost recovery during a rate cap period

Q12-13-14: Barriers to CCT implementation

Census Division and State	Q12	Q13	Q14
New England			
Connecticut			
Maine			
Massachusetts			
New Hampshire	EP	C	MR
Rhode Island			
Vermont			
Middle Atlantic			
New Jersey			
New York	CP	CS	GP
Pennsylvania	PU	S5	ES5
East North Central			
Illinois	UW	U	N2
Indiana	C	C	N3
Michigan	EU4	U3S2	GIR
Ohio	N	E	IP
Wisconsin	E14	SU	IPR
West North Central			
Iowa	C2U3	CSU	RS
Kansas	A	P	
Minnesota	AP5	U	EPR
Missouri	N	N	N
Nebraska	C	C	
North Dakota	EL6	C	
South Dakota	AL	C	N5
South Atlantic			
Delaware			
District of Columbia	PS		
Florida	CPS1	CFS	N1
Georgia			
Maryland			
North Carolina			
South Carolina	CE	CF	N4
Virginia	C11E13L10P12UW	CSU7	GR
West Virginia	C	C8U9	IR
East South Central			
Alabama	C	C	S
Kentucky	ELP	S	EIR
Mississippi	CN15	CS	N
Tennessee	C7E8P	C	EIMPS
West South Central			
Arkansas	L	CS	
Louisiana			
Oklahoma			
Texas	CEU9	FS6	N4
Mountain			
Arizona			
Colorado			
Idaho			
Montana			
Nevada			
New Mexico	N		
Utah			GS
Wyoming			
Pacific Contiguous			
California			
Oregon	AS	CF	
Washington	?	CS	N
Pacific Noncontiguous			
Alaska	CL	E	S
Hawaii			
U.S. Total			

Coding rules for Q14

#: refer to the corresponding footnote

E: Educate public on CCT & its difference from conventional coal fired plants and the need for fuel diversity.

G: Governmental actions--
Set IRP standards for capacity expansion planning that values fuel diversity, level the playing field between regulated and deregulated markets by requiring fuel diversity in portfolio

I: Incentives-- state, financial or otherwise
tax incentives for CCT, tradeable tax credits, incentives for CHP at existing plant, influence federal legislation

M: Market means-- use allowances in a cap & trade program, create tradeable emissions credits.

N: None or not aware of any

P: Promotion--
promote pilot projects, (co)fund R&D on CCT (incl. Retrofit) of 100MW or larger, encourage life extension, and encourage R&D to improve CCT's cost and environmental characteristics

R: Ratemaking--
ratemaking principle to regognize higher risks of CCT, allow preferred ratemaking treatment & accelerated depreciation, allow higher ROE to create incentives for CCT investment, assure cost recovery for emission reducing technologies, enable regulated utilities to recover fossil-related compliance costs through State environmental surcharge.

S: Streamlining regulatory processes--
RFP process streamlined to meet supply-side needs in a least cost, reliable manner, assure plans are cost effective and balance the economic development and environmental needs, formulate one stop siting &/or environmental review process, reform the prevention of significant deterioration and new source review regulations to encourage CCT

Blank: No information

Q14 - Footnotes:

1- Other than the low price of natural gas and the existence of CCG technology, there are no regulatory barriers

2- The barriers are economic and physical, not regulatory. The economic barriers are the additional cost of CCT. The physical barrier is the lack of transmission capacity to take power from coal locations to the load.

3 - The Commission is a neutral fact-finding agency. The Department of Commerce is the promotional body.

4 - The cost of CCT is the primary barrier.

5- Public policy must reconcile any regulatory contradiction between the desire to deploy new CCT and retrofit older plants against new regulatory requirements imposed as a result of the new technology or retrofit.

6 - Limited because we have very little coal-fired generation sited

Q15-17:
CCT adoption potential

Q 18-19:
Public acceptance

Census Division and State	Q15	Q16	Q17	Q18	Q19
New England					
Connecticut					
Maine					
Massachusetts					
New Hampshire	NC	N	C	N	N[8]
Rhode Island					
Vermont					
Middle Atlantic					
New Jersey					
New York	YP	RL	YG1	N	Y[9]
Pennsylvania	YBDF	YM	C	N	Y[10]
East North Central					
Illinois	YEFI		YG2	W	Y
Indiana	YF	PM		N	Y
Michigan	YF	N	N	N	Y[5]
Ohio	YF	Y	CRS	N	Y
Wisconsin	YF	PL?	C	N	W
West North Central					
Iowa	QCG	N	N	N	Y[3]
Kansas	YE	N	N	N	Y[4]
Minnesota	QO	R	N	YLO*	N[6]
Missouri	YE	RL?	N	W	W
Nebraska	YEG	N	N	N	Y[7]
North Dakota	YGP	RL	R	N	Y
South Dakota	Y	PL	N	N	Y[12]
South Atlantic					
Delaware					
District of Columbia	N	N	N	N	N
Florida	YE	M?	YCG2	YLO*	N[2]

Georgia	YB	YP	YCG2		Y
Maryland					
North Carolina		N	N	N	W
South Carolina	YC	Y	N	N	C[11]
Virginia	YF	PL	N	YL*	Y[15]
West Virginia	YF	N	N	N	Y
East South Central					
Alabama	Y	N	S	N	Y
Kentucky	YF	YM	N	N	Y
Mississippi	YB		YG1	N	Y[16]
Tennessee	YF	Y	N	N	C[13]
West South Central					
Arkansas	YG	PL?	N	N	Y
Louisiana					
Oklahoma					
Texas	YF	N	N	N	C[14]
Mountain					
Arizona					
Colorado					
Idaho					
Montana					
Nevada					
New Mexico	Y	N	N	N	Y
Utah	YF	N	N	N	W
Wyoming					
Pacific Contiguous					
California					
Oregon	N	N	N	N	N
Washington	NO	N	N	N	N
Pacific Noncontiguous					
Alaska	QD	YD	YG1	N	Y[1]
Hawaii					
U.S. Total					

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Coding rules for Q15-17

Common codes:
N: No/None
Y: Yes/ There is
Blank: No information

Coding for Q15
(presumtion: there must be a need)
B: Plants being built/planned
C: access to coal is an issue
D: Demo exist(ed), or under construction
E: if economical
F: Conditions very favorable
G: elec infrastructure upgrade needed
I: Govt. incentives exist
O: Public opposition to coal
P: Plants proposed
Q: Unlikely

Coding for Q16:
(No distinction made between generation
& control technologies)
D: small Demo
L: > 600 MW (all plants combined)
M: 100-600 MW (all plants combined)
P: Permitting underway
R: proposed
?: May be conventional coal plant

Coding for Q17
(COMPLETE, ACTIVE, OR FIRMLY PLANNED)

S: Research only
G#: Number of generation tech
C: One or more control tech demo or implemented
R: CCT related technology

Coding rules for Q18-19

Common codes:
N: None
Y: Yes
W: Uncertain
Blank: No information

Coding for Q18:
D: small Demo
L: > 600 MW (all plants combined)
M: 100-600 MW (all plants combined)
*: due to rate of return concerns
O: due to public opposition

Coding for Q19:
#: see corresponding FOOTnote
C: Conditional

Q19 - Footnotes:

1 - No significant negative opinion, per se. They sited the Healy CCT project adjacent to Denali National Park through an agreement with environmental groups.
2 - Unless the price of natural gas rise significantly for a prolonged period of time
3 - IUB has been required by legislation to balance both environmental and economic development impacts of utility plans to deal with power emissions. To the extent that CCT can be reasonably cost effective (with no negative impact on economic development) the IUB believes that there will be adequate public support for a CCT generation to be sited during the next five years.
4 - Particularly for locations in southeast KS with waste coal problems would support it for jobs and potential environmental benefits
5 - Especially if located on a "brownfield" or existing coal plant site.
6 - Pessimistic due to inadequate public, political, and regulatory support
7 - There might be adequate support to site a CCT generator in the next five years, but only if there is a demonstrated need for the generation resources at the state or local level.
8 - Doubtful. Public support is for natural gas-fired generation
9 - But no one has come forward with a proposal.

11 - Depending on location, owner, and impacts of alternatives and costs
12 - Otter Tail plans, other than siting, are on hold
13 - if replacing existing coal-fired facilities
14 - Texas has adequate reserve margins to meet peak demand during the next five years. However, if demand exceeds supply beyond the five year timeframe, public support for CCT would increase. Nevertheless, during the last ten years contemplated coal-fired plants failed to materialize due to the low cost of gas-fired generation.
15 - within the context of removing barriers previously noted, regional public support
16 - Judging from the Tractebel FBC plant that just came online

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Table 1: Assessment of CCT Potential

Census Division & State	Coal fired capacity code by installed MW			as % of total	CCT Control devices			CCT generation tech		Regulatory			Barriers			CCT deployment opportunities			Public acceptance	
	Utility	Nonutility	State	State	3 SOx	4 NOx	5 SOx-NOx	6-7 FBC	8-9 IGCC	10-1 Jurisdiction	10-2 Siting	11 g opportunit	Q12 to new CCT	Q13 to Retrofit	Q14 reduction	Q15	Q16	Q17	Q18	Q19
New England																				
Connecticut	0	0	0	0																
Maine	0	0	0	0																
Massachusetts	0	1	1	2																
New Hampshire	0	0	0	1	F	ACNR							EP	C	MR	NC	N	C	N	N_8
Rhode Island										K		C								
Vermont																				
Middle Atlantic																				
New Jersey	0	0	1	1																
New York	1	2	2	1	S	NR	D						CP	CS	GP	YP	RL	YG1	N	Y_9
Pennsylvania (1)	4	4	5	3	SL	ACNR	D	E	C	G		FT	PU	S_5	ES5	YBDF	YM	C	N	Y_{10}
East North Central										L	25	F*								
Illinois (1)	3	3	5	3	S	NR		E	P				UW	U	N_2	YEFI		YG2	W	Y
Indiana (1)	5	0	5	5	IDL			CP	E	B		?	C	C	N_3	YF	PM		N	Y
Michigan (2)	4	0	4	4		ANR				A		**F	EU_4	U_3S_2	GIR	YF	N	N	N	Y_5
Ohio (1)	5	0	5	5	F	NR				L		EFST	N	E	IP	YF	Y	CRS	N	Y
Wisconsin (3)	3	0	3	4	F	NR*		C	P	H		F	E_{14}	SU	IPR	YF	PL?	C	N	W
West North Central										C	?									
Iowa	2	0	2	5	F	CN		I					C_2U_3	CSU	RS	QCG	N	N	N	Y_3
Kansas	2	0	2	4	F			C					A	P		YE	N	N	N	Y_4
Minnesota	2	0	2	4	F	A		EP*	P	D		T	AP_5	U	EPR	QO	R	N	YLO*	N_6
Missouri (3)	3	0	3	5	S	NR				C			N	N	N	YE	RL?	N	W	W
Nebraska	1	0	1	4		N		E		F			C	C		YEG	N	N	N	Y_7
North Dakota	2	0	2	5	S	AN		E		A*		HS	EL_6	C		YGP	RL	R	N	Y
South Dakota	0	0	0	2	F	M				A*		DF	AL	C	N_5	Y	PL	N	N	Y_{12}
South Atlantic										A	2	FST								
Delaware	0	0	0	3																
District of Columbia													PS			N	N	N	N	N
Florida (2)	4	0	4	2	S	NR*		EP	E				CPS_1	CFS	N_1	YE	M?	YCG2	YLO*	N_2
Georgia (2)	4	0	4	4	FST	ANR			EP	CI	12	FJT				YB	YP	YCG2		Y
Maryland	2		2	3						L										
North Carolina (2)	4	0	4	4		R											N	N	N	W
South Carolina	2	0	2	3	SL	AMNR				A*	25		CE	CF	N_4	YC	Y	N	N	C_{11}
Virginia (3)	2	0	3	3	FLS	CNR	D	EP	P*	CE	12345*	*	$C_{11}E_{13}L_{10}P_{12}UW$	CSU_7	GR	YF	PL	N	YL*	Y_{15}
West Virginia (1)	4	0	4	5	FS	ANR		E		A	1	FT*	C	C_8U_9	IR	YF	N	N	N	Y
East South Central										A	1	E								
Alabama (2)	5	0	4	4	FS	NR							C	C	S	Y	N	S	N	Y
Kentucky (1)	4	1	4	5	L	NR		P		B		EF*	ELP	S	EIR	YF	YM	N	N	Y
Mississippi	1	0	1	2	*	*		E		AB		D	CN_{15}	CS	N	YB		YG1	N	Y_{16}
Tennessee (3)	3	0	3	4					*	A			C_7E_8P	C	EIMPS	YF	Y	N	N	C_{13}
West South Central										I		CFT*								
Arkansas	2	0	2	3									L	CS		YG	PL?	N	N	Y
Louisiana	2	1	2	2																
Oklahoma	2	0	2	4						BC	12	F								
Texas (1)	5	0	5	2				E					CEU_9	FS_6	N_4	YF	N	N	N	C_{14}
Mountain																				
Arizona	3	0	3	3						LA*		S*								
Colorado	2	0	2	5																
Idaho	0	0	0	0																
Montana	1		2	3																
Nevada	1	0	2	3																
New Mexico	2	0	2	5									N			Y	N	N	N	Y
Utah	2	0	2	5	S	N		E	C						GS	YF	N	N	N	W
Wyoming	3	0	3	5						C		*								
Pacific Contiguous										B	1									
California	0	0	0	0																
Oregon	0	0	0	0		R*							AS	CF		N	N	N	N	N
Washington	1	0	1	0	L			E						CS	N	NO	N	N	N	N
Pacific Noncontiguous										I										
Alaska	0	0	0	0	S	N		N		CH			CL	E	S	QD	YD	YG1	N	Y_1
Hawaii	0	0	0	0																
U.S. Total										L		FS								