GUIDE TO IPM Output FILES

EPA Base Case

v.5.13

The following information is meant to provide users with a general explanation of the different IPM output files that are made web ready and posted to EPA's website. It refers to the EPA Base Case v.5.13 that was designed and developed for use in analyzing policy scenarios starting in 2016. It is meant to help users identify and interpret the data available in the model input and output files. The EPA Base Case v.5.13 documentation (available at http://www.epa.gov/airmarkets/progsregs/epa-ipm/BaseCasev513.html provides more comprehensive details regarding the assumptions and methodology used in the model.

Below is a brief overview of the non-unit level IPM inputs and outputs that are made publically available through EPA's website. Because the System Summary Report is one of the more frequently referenced documents that summarizes many IPM key outputs, it is described in further detail in the remainder of this guide.

Once EPA Base Case v.5.13 files are downloaded and decompressed from EPA's website, the unzipped files will contain two folders: "Input and Output Files" & "Parsed Files". Additionally, it will have an Excel spreadsheet that includes "System Summary Report" in the title. The "Input and Output Files" folder will have six files within it: A DAT Replacement file, RPE Replacement file, RPT Replacement files, EIA Style Gas Report, State Emission File, and an Overview file.

Input and Output Files

DAT file (Model Inputs): This file will have "dat file" in the file name, e.g., "Base Case dat file.xlsx." This file replaces ".dat" file that was output by earlier versions of IPM and is easier to navigate. It contains the key input set-up data used to define the model run, including the definitions and specifications for run years, model regions, model plants, financial parameters, available fuels, and power system transmission and operating parameters. The "Index" worksheet provides a list of all other worksheets and data available in the file, and the "RunUniverse" worksheets includes a table of region names and IDs.

RPE file (Model Plant Outputs): This file will have "rpe file" in the file name, e.g., "Base Case rpe file.xlsx." This file replaces ".rpe" file that was output by earlier versions of IPM and is easier to navigate. For each model plant, this file shows the projections of fuel consumption, emissions, capacity, costs (capital, fixed operations and maintenance, and variable operations and maintenance), and generation.

RPT files (Detailed Model Operational Outputs): This is a zip file with "rpt files" in the file name, e.g., "Base Case rpt files.zip." It contains multiple excel workbooks that replace the ".rpt" file that was output by earlier versions of IPM and is easier to navigate. These files contain a variety of model outputs, including: regional summaries; costs, fuel supply,

transportation, and use; electricity transmission and constraints; new and retrofit capacity; environmental constraints; and energy price.

EIA Style Gas Report file: This file will have "EIA Style Gas Report" in the file name, e.g., "Base Case EIA Style Gas Report.xlsx." This file shows outputs related to natural gas production and use in format matching natural gas tables developed by the Energy Information Administration (EIA).

State Emissions file: This file will have "State Emissions" in the file name, e.g., "Base Case State Emissions.xlsx." This file shows EGU emissions at the state level for each run year, derived from the IPM regional level results. . There are two tabs, one showing emissions from all EGUs, the other showing emissions only from fossil units greater than 25 MW.

Overview file (Regional Summary of Model Operational Outputs): This file will have "Overview" in the file name, e.g., "Base Case Overview File.xlsx." It contains model operational outputs by run year at the regional level, including capacity, generation, costs, retrofits, and retirements. It is typically easier for users to refer to either the System Summary Report or the Regional Summary File/

System Summary Report

System Summary Report: The System Summary Report is available as a spreadsheet, e.g., "Base Case SSR. xlsx." It contains system-wide power sector results for the lower continental U.S. for each run year. It reports forecasted generation, capacity, capacity additions, capacity factors, production costs, emissions, fuel consumption & cost, and allowance prices by model run year. Disaggregation of system-wide data to plant type data is provided for generation and capacity fields. The plant types are categorized based on fuel used (e.g., coal, oil/gas, nuclear, hydro), combustion technology (e.g., turbine, combined cycle gas), control technology (e.g., scrubber, post-combustion NO_x control), and retrofit structure (e.g., coal plant with existing SNCR retrofit with ACI). In addition to providing the above outputs forecasted for each model run year, it also gives information on the various regulatory and legal requirements that were inputted into the model as constraints. Below is a more detailed explanation of each worksheet in the System Summary Report.

The regional level equivalent of the System Summary Report Tables 1-16 is available in the "Regional Summary.xlsx" file that is included in the RPT replacement files.

Description of Worksheets and Data within the System Summary Report File

System Summary Report: When the Excel File is opened, it will contain six worksheets

1. "Summary" worksheet
2. "All Constraints" worksheet
3. "Fuel Report" worksheet
4. "Tables 1-16_US" worksheet
5. "Coal Pivot Tables" worksheet
6. "Final Wholesale Price" worksheet

Summary Worksheet: The summary worksheet in the system summary file highlights some of the key data points from the IPM output, and is intended to be an ideal starting point for assessing fundamental environmental and operational projections for the power sector in any given IPM run. For first time users, it is one of the more user friendly documents from which to view output data. See Appendix 1-1 for description of fields included in the "Summary" worksheet.

All Constraints: The "All Constraints" worksheet in the System Summary Report provides information on various legal and policy requirements and how they are captured in the model. Each constraint typically involves a "standard" that is imposed in the form of an emission limit, emission rate limit, or generation limit. The constraint can be applied at the unit, plant, system, state, regional or national level. The constraints also include a time dimension and may vary between model run years. Each constraint in the worksheet provides information on the impact of the "standard" on the effected unit(s). These impacts are modeling outputs given in the form of emissions, emission rates, and/or generation that occur under the given "standard" in a particular model run year. For constraints that represent cap-and-trade programs with banking, the run output indicates additions and withdraws from the allowance bank and allowance price by year. There are nearly 1000 constraints in the EPA Base Case v.5.13 Base Case, and the total number may extend beyond a thousand for the modeling of certain policy scenarios. An example of a constraint would be "Constraint Name: #1 –SO2 CAIR Annual Constraint" which captures the emission limits imposed on coal units by the Clean Air Interstate Rule. The constraint provides a total "standard" that reflects the CAIR allowances available to units in a given model run year. Below is a table that illustrates the typical format of a constraint in the "All Constraints" worksheet, along with an explanation of each row. Appendix table 2-1 provides a comprehensive list of legal and policy requirements that are reflected in the model through the various constraints.

Description of Constraint Level Data Fields

Row Title	Description
Constraint Name: #1 - SO2 CAIR Annual Constraint	Provides information on legal or policy constraint being modeled.
Constraint Type: Rate Constraint in Mtons	Provides information on constraint type that is being modeled (e.g., generation, emission, rate, etc.). "Mtons"= thousand tons (emission limit); "GWh" = gigawatt hours (generation limit); "lbs/Mmbtu" = pounds per million btus (rate limit).
Seasons Included	Shows model run year for the output and indicates if the constraint was applied to summer generation, winter generation, or both. Winter months include October through April. Summer months include May through September.
Standard	This row provides the value of the constraint being inputted into the model. It is modeling input and one of key interest in the “All Constraints” worksheet.
Emissions at Affected Plants	Model output of collective emission at plants affected by "standard" as well as summary of allowance trading activity supporting the emission level.
Allowances Purchased SO2	
Allowances Sold SO2	
Allowances Banked	
Allowances Withdrawn (1:1)	
Allowances Withdrawn (n:1)	
Net Emissions Allowance Position	
Fuel Consumed	Tbtu=trillion btu. Model output of fuel consumption for affected units.
Rate	Model output of emission rate for effected units. "lbs/Mmbtu" = pounds per affected unit.
Generation	Electricity generated by units subject to the "standard" limit. TWh = Terawatt hours generated.
Qualifying Generation	
Rate	Rate for affected units. lb/MWh = pound per Megawatt hour.
Constraint Shadow Price	If the "standard" is an emission limit (i.e., cap) in a trading program, the constraint shadow price will reflect the $ per ton value of allowances in that trading program. Commonly called the “allowance price”.

Fuel Report: The "Fuel Report" worksheet provides consumption and cost data for major power sector fuel sources for each model run year. These fuels include coal, nuclear, natural gas, biomass, pet.coke (petroleum coke), natural gas, biomass, waste coal, and oil. For each fuel type the total consumption is given in TBtus (trillion Btus). Cost is provided in both MMUS$ (million US dollar units) and US$/MMBtu (U.S. dollar per million Btus).

Tables 1-16: The "Tables 1-16" worksheet in the System Summary Report provides information on controls, generation, capacity, and cost. The information in these tables is often the disaggregated value of the totals reported in the "Summary" worksheet. A user interested in better understanding the details behind the totals given in the "Summary" worksheet may wish to consult "Tables 1-16". For example, the "Summary" worksheet provides the total amount of generation from coal in a given model run year. However, the "Tables 1-16" worksheet goes one step further and provides data on the portion of that generation total coming from coal plants with no pollution control and the portion coming from plants with specific pollution control configurations. In particular, tables 10 through14 provide generation and capacity data at the model plant type level. Tables 1–9 provide generation supply and demand data at the U.S. region wide level. The table below describes the data output reported in each table, and Appendix 3-1 and 3-2 provides more information on the acronyms and nomenclature used in the data fields.

Description Tables in "Tables 1-16" Worksheet

Table #	Title	Description
1	Reserve Margin Capacity Winter (MW)	Shows total electric generating capacity available to the U.S. region during winter period. Available supply of electricity in megawatts (MW).
2	Peak Load Winter (MW)	Shows total electricity demand during winter period by the U.S. region. Capacity reported in megawatts (MW).
3	Reserve Margin Winter (%)	Shows excess winter capacity supply as percentage of demand using total values reported from Tables 1 & 2. (supply - demand)/demand.
1	Reserve Margin Capacity summer (MW)	Shows total electric generating capacity available to U.S. region during summer period. Available supply of electricity in megawatts (MW).
2	Peak Load summer (MW)	Shows total electricity demand during summer period by the U.S. region. Capacity reported in megawatts (MW).
3	Reserve Margin summer (%)	Shows excess summer capacity as percentage of demand using total values reported from Tables 1 & 2.

1	Reserve Margin Capacity annual (MW)	Shows total electric generating capacity available to U.S. region annually. Available supply of electricity in megawatts (MW).
2	Peak Load annual (MW)	Shows total electricity demand annually by the U.S. region. Capacity reported in megawatts (MW).
3	Reserve Margin annual (%)	Shows excess annual capacity as percentage of demand using total values reported from Tables 1 & 2.
4	Generation (GWh)	Gigawatt hours (GWh) of annual electricity that is produced domestically, imported, exported, and lost during pumping and storage.
5	Total Supply for Demand (GWh)	Gigawatt hours (GWh) of annual electricity generation supplied to the U.S. region. Summation of values in Table 4
6	Projected Demand (GWh)	Gigawatt hours (GWh) of annual projected demand and projected net demand.
7	Dumped Energy	Typically not referenced.
8	Total Generation	Gigawatt hours (GWh) of annual electricity that is produced domestically, imported, exported, and lost during pumping and storage.
9	Total Sales (GWh)	Gigawatt hours (GWh) of annual electricity supply determined by subtracting projected transmission & demand losses from total supply.
10	Capacity by Capacity Reporting Type	Cumulative capacity (MW) of model plant types for each model run year. The model run plants are categorized by the unit's fuel, configuration, and online status (e.g., new, existing, retiring). Each control configuration combination is modeled as a separate plant type. The total capacity, retrofit capacity, new unit capacity, and retiring unit capacity values given in the summary table are disaggregated into model plant types in this table. Key difference between table 10 & 11 is that 10 is cumulative and 11 is incremental. Therefore, table 10 will show model plant capacity by a given year, and table 11 will show model plant capacity added during that run year.
11	Capacity Additions and Changes	Incremental capacity (MW) of model plant types for each model run year. The model run plants are categorized by the unit's fuel, configuration, and online status (e.g., new, existing, retiring). Each control configuration combination is modeled as a separate plant type. The total capacity, retrofit capacity, new unit capacity, and retiring unit capacity values given in the summary table are disaggregated into model plant types in this table.

12	Generation by Capacity Reporting Type (GWh)	Cumulative generation (GWh) of model plant types for each model run year. The model run plants are categorized by the unit's fuel, configuration, and online status (e.g., new, existing, retiring). Each control configuration combination is modeled as a separate plant type. The total generation by each plant type given in the summary table is disaggregated into model plant type generation in this table.
12a	Generation by Capacity Reporting Type (GWh)	Total gigawatt hours (GWh) of generation in each model run year by fuel type. Aggregation of the model plants pertaining to each fuel in table 12.
13	Generation by Capacity Reporting Type (Tbtu)	Cumulative generation measured in Trillion btus (Tbtu) of model plant types for each model run year. The data corresponds to generation values given in Table 12, but is expressed in TBtus to provide the heat content of the power generated. Conversion factor of approximately 3,412 Btu/KWh is used.
14	Capacity factor by Capacity Reporting Type (%)	Capacity factor for each model plant type. Capacity factor is the actual generation expressed as a percentage of maximum generation possible if the plant was operated every hour of the year. Therefore, it is the generation / (capacity*8760). Generally, the model does not allow for 100% capacity factors because of maintenance, planned outage, and forced outage times. Intermittent generation sources (i.e., wind) also have their capacity factor limited by the availability of their fuel source.
15	Total Annual Production Cost	Provides total production cost in million U.S. dollar units (MMUS$) for each model run year. The production costs are disaggregated into variable operating and maintenance (variable O&M), fixed O&M, fuel, capital, and CO2 transportation and storage cost.
16	Emissions	Provides total annual U.S. emissions for each model run year for several hazardous, criteria, and green house gas pollutants. Emission totals are expressed in 1000 tons (Mtons); 1,000,000 tons (MMtons), or regular tons. All tons are short tons (2000 lbs/ton) unless otherwise noted.

Coal Pivot Tables: The "Coal Pivot Tables" worksheet in the System Summary Report provides information on coal prices and total coal consumption for each run year by coal region. Data is reported in both MMBtu and tons.

Final Wholesale Price: The "Final Wholesale Electricity Price" worksheet in the System Summary Report provides the wholesale electricity price for each region and model run year.

APPENDICES

Appendix 1-1: Description of Data Fields in "Summary" Worksheet

Row Number	Row Title	Description of Field
1		
2	**EPA IPM Run Results**	
3	***All costs and prices are in 2011-year dollars***	Provides year to which all cost and prices within the summary report are indexed.
4	**NATIONWIDE EMISSIONS**	Provides nationwide total emissions from EGUs for given run years in short tons (2000 lbs/ton) unless otherwise noted.
5	**SO2 (million tons)**	
6	**NOx (million tons)**	
7	**CO2 (million metric tons)**	
8	**Hg (tons)**	
9	**HCL (Mtons)**	
10		
11	**TOTAL COSTS**	Provides the total cost of electricity generation to meet demand in given year under the modeled operational, regulatory, and policy constraints. Values are given in billion dollar units and indexed to 2007 prices.
12	**Total Costs (billion $)**	
13		
14	**PRICES**	Gives the prices for various fuel and emission commodities relevant to the power sector.

15	**National Wholesale Electricity Price (mills/kWh)**	For wholesale electricity prices in “mills/kWh”. 1 mill = 1/10 of a cent. Therefore, 10 mills/kWh is equivalent to $.01/kWh.
16	**Natural Gas Prices (2011 $/MMBtu)**	"MMbtu" = million btus.
17	Henry Hub	Price at Henry Hub. Henry Hub is a gas pipeline in Louisiana that serves as a generally accepted reference point for U.S. natural gas trading data due to its central location giving shippers access to pipelines in the southeast, midwest, and northeast regions.
18	Delivered	Delivered price of gas. Reflects seasonal and transportation cost adders.
19	**Minemouth Coal Prices (2011 $/MMBtu)**	Provides endogenously determined minemouth coal prices. "MMbtu" = million btus. Figure 9-1 of the Documentation for EPA Base Case v.5.13 for a map of coal regions. National price is weighted average of regional coal prices.
20	Appalachia	
21	Imports	
22	Interior	
23	Waste Coal	
24	West	
25	National	
26		
27	**EMISSION ALLOWANCE PRICES ($/Ton)**	
28	SO_2 Annual (CAIR)	SO_2 Annual (CAIR) Provides emission allowance price for pollutants under that program.
29	NO_x Annual (CAIR)	NO_x Annual (CAIR) Provides emission allowance price for pollutants under that program.
30	NO_x Ozone Season (CAIR)	NO_x Ozone Season (CAIR Provides emission allowance price for pollutants under that program.

31	CO_2 ($/metric ton)	CO_2 ($/metric ton)
32		
33	**EMISSION CONSTRAINTS (Mtons)**	Mtons = Thousand Tons
34	SO_2 Annual (CAIR)	SO_2 Region 1 (CAIR) Provides total emissions for electric generating units (EGUs) affected by the referenced policy.
35	NO_x Annual (CAIR)	NO_x Annual (CAIR) Provides total emissions for electric generating units (EGUs) affected by the referenced policy.
36	NO_x Ozone Season (CAIR)	NO_x Ozone Season (CAIR) Provides total emissions for electric generating units (EGUs) affected by the referenced policy.
37	CO2 (metric ton)	CO2 (metric ton) Provides total emissions for electric generating units (EGUs) affected by the referenced policy.
38		
39	**TOTAL CAPACITY (Cumulative GW)**	Provides the cumulative gigawatts of generating capacity by plant type forecasted to be online for a given run year. It reflects ((existing units + new units) – retiring units) for that generation type. The existing value is obtained from the previous model run year. Total is the aggregate electricity generating capacity available. Abbreviations: PC = pulverized coal; IGCC = integrated gasification combined cycle; IGCC-CCS = integrated gasification combined cycle with carbon capture and storage; CC = combined cycle; CT = combustion turbine.
40	**Hydro**	
41	**Non-Hydro Renewables**	
42	Biomass	
43	Other	
44	Wind	
45	**Coal**	
46	PC	
47	IGCC	
48	IGCC - CCS	

49	**New Future Technology**	
50	**Nuclear**	
51	**Natural Gas**	
52	CC	
53	CC - CCS	
54	CT	
55	**Oil/Gas Steam**	
56	**Other**	
57	**Grand Total**	
58		
59	**NEW CAPACITY (Cumulative GW)**	Provides the cumulative gigawatts of new capacity by plant type expected to come online by a given run year (. New capacity is determined endogenously and constitutes units that are not currently listed in the National Electric Energy Data Source (NEEDs). Abbreviations: PC = pulverized coal; IGCC = integrated gasification combined cycle; IGCC-CCS = integrated gasification combined cycle with carbon capture and storage; CC = combined cycle; CT = combustion turbine.
60	**Non-Hydro Renewables**	
61	Biomass	
62	Other	
63	Wind	
64	**Coal**	
65	PC	
66	IGCC	

67	IGCC - CCS	
68	**New Future Technology**	
69	**Nuclear**	
70	**Natural Gas**	
71	CC	
72	CC - CCS	
73	CT	
74	**Other**	
75	**Grand Total**	
76		
77	**RETIREMENTS (GW)**	Provides the cumulative gigawatts of retirements by plant type that occur by the given run year. Abbreviations: PC = pulverized coal; IGCC = integrated gasification combined cycle; IGCC-CCS = integrated gasification combined cycle with carbon capture and storage; CC = combined cycle; CT = combustion turbine; O/G = oil/gas steam. In some cases, retirements may also reflect retirements that are required by enforcement actions (e.g., consent decree).
78	CC Retirements	
79	Coal Retirements	
80	CT Retirements	
81	Nuclear Retirements	
82	O/G Retirements	
83	IGCC Retirements	
84	Non-Fossil Retirements	

85	Grand Total	
86		
87	**GENERATION MIX (thousand GWh)**	Provides the annual generation projected for a given model run year by a particular plant type. Generation data is given in units of 1000 gigawatt hours. The total value reflects total electricity demand from the power grid. Abbreviations: PC = pulverized coal; IGCC = integrated gasification combined cycle; IGCC-CCS = integrated gasification combined cycle with carbon capture and storage; CC = combined cycle; CT = combustion turbine; O/G = oil/gas steam.
88	**Hydro**	
89	**Non-Hydro Renewables**	
90	Biomass	
91	Other	
92	Wind	
93	Biomass Co-firing	
94	**Coal**	
95	PC	
96	IGCC	
97	IGCC - CCS	
98	**New Future Technology**	
99	**Nuclear**	
100	**Natural Gas**	
101	CC	
102	CC - CCS	

103	CT	
104	**Oil/Gas Steam**	
105	**Other**	
106	**Grand Total**	
107		
108	**TOTAL CONTROLS (Cumulative GW)**	Provides total gigawatts of a particular type of control technology at coal-fired units.
109	**FGD**	Provides total gigawatt of units with Flue Gas Desulfurization technology (FGD) for a given run year. FGD is used for removing SO_2 from coal fired power plants. Also referred to as a "scrubber". The total given is a summation of existing scrubbers, retrofit scrubbers, and all new pulverized coal capacity which is assumed to have scrubber technology installed.
110	Existing Scrubber	Provides total gigawatt of coal steam capacity in NEEDS with a FGD. These FGDs are exogenous to the model and in place prior to retrofits and new units that are added in the model. Wet FGD refers to limestone forced oxidation (LSFO) and Dry FGD refers to Lime Spray Dryer (LSD) technology.
111	Existing Wet Scrubber	
112	Existing Dry Scrubber	
113	Non-Disapatchable Scrubber	Provides gigawatts of FGD retrofits for a given model run year. These are model projections and therefore endogenous to the model.
114	Retrofit Wet Scrubber	
115	Retrofit Dry Scrubber	
116	New Scrubber	Refers to cumulative GW of new FGDs online by a given model run year. Corresponds to the capacity of cumulative new pulverized coal capacity expected for a given model run year. The model assumes all new pulverized coal has FGD controls.
117	New Wet Scrubber	
118	New Dry Scrubber	

119	**SCR**	Provides total gigawatts of Selective Catalytic Reduction (SCR) online by a given model run year (Existing + retrofits + new units). SCRs are primarily used as a post-combustion technology for reducing NO_X from emissions at power plants.
120	Existing SCR	Provides total gigawatt of coal steam capacity in NEEDS with a SCR. These SCRs are exogenous to the model and in place prior to retrofits and new units that are added in the model
121	Retrofit SCR	Refers to cumulative gigawatts of capacity retrofitted with SCR by a given model run year. These are model projections and therefore endogenous to the model.
122	New SCR	Refers to the cumulative gigawatts of new SCRs (non-retrofits) that have come online by a given model run year. Corresponds to capacity of new coal units that is forecasted, as all new coal is assumed to have SCR.
123	**SNCR**	Provides total cumulative gigawatts of Selective Non-Catalytic Reduction (SNCR) technology that is online by a given model run year. Summation of existing, retrofit, and new SNCR. SNCR is post-combustion technology for reducing NO_X from power plant emissions.
124	Existing SNCR	Provides total gigawatt of coal steam capacity in NEEDS with a SNCR. These SNCRs are exogenous to the model and in place prior to retrofits and new units that are added in the model
125	Retrofit SNCR	Refers to cumulative gigawatts of capacity that is retrofitted with SNCR by a given run year. These are model projections and therefore endogenous to the model.
126	**ACI**	Provides cumulative GW of generating capacity that has Activated Carbon Injection (ACI). Is a summation of existing, retrofits, and new ACI. ACI is technology for reducing Mercury (Hg) emissions at power plants.
127	Existing ACI	Provides total gigawatt of coal steam capacity in NEEDS with a ACI. These ACIs are exogenous to the model and in place prior to retrofits and new units that are added in the model
128	Retrofit ACI	Provides cumulative gigawatts of generating capacity that is retrofitted with ACI by the given model run year. These are model projections, and therefore endogenous to the model.

129	New ACI	Provides cumulative gigawatts of new units that are coming online with ACI technology.
130	**CCS**	Provides cumulative gigawatts of generating capacity that has Carbon Capture and Storage Technology installed by a given model run year. Is a summation of existing, retrofit, and new CCS.
131	Hardwired CCS	Provides total gigawatts of existing CCS that is online prior to 2012 and included in the modeling input in the NEEDs inventory. This is exogenous to the model.
132	Retrofit CCS	Provides total cumulative gigawatts of capacity that is retrofitted with CCS by the given model run year. These are model projections and therefore endogenous to the model..
133	New CCS	Provides cumulative gigawatts of new units that are coming online with CCS by the given model run year.
134	**FF**	Provides cumulative gigawatts of generating capacity that has Fabric Filter technology installed by a given model run year. Is a summation of existing and retrofit Fabric Filters.
135	Existing FF	Provides total gigawatt of capacity in NEEDS with a Fabric Filter. These fabric Filters are exogenous to the model and in place prior to retrofits and new units that are added in the model
136	Retrofit FF	Provides total cumulative gigawatts of capacity that is retrofitted with Fabric Filters by the given model run year. These are model projections and therefore endogenous to the model.
137	**DSI**	Provides cumulative gigawatts of generating capacity that has Dry Sorbent Injection technology installed by a given model run year. Is a summation of existing, retrofit, and new DSI.
138	Existing DSI	Provides total gigawatt of coal steam capacity in NEEDS with a DSI. These DSIs are exogenous to the model and in place prior to retrofits and new units that are added in the model
139	Retrofit DSI	Provides total cumulative gigawatts of capacity that is retrofitted with DSI by the given model run year. These are model projections and therefore endogenous to the model.
140	**C2G**	Provides the cumulative gigawatts of capacity that is converted from burning coal to natural gas by the given model run year.

141	**HRI**	Provides the cumulative gigawatts of capacity that has heat rate improvements by the given model run year.
142		
143	**RETROFITS (Cumulative GW)**	Provides total cumulative gigawatts of capacity that is retrofitted with a given technology post 2015 and by given model run year. The capital costs of the retrofits are included in the model and they are installed at the power plant post 2015.
144	**FGD**	Cumulative gigawatts of Flue Gas Desulfurization.
145	**SCR**	Cumulative gigawatts of Selective Catalytic Reduction retrofits.
146	**SNCR**	Cumulative gigawatts of Selective Non-Catalytic Reduction retrofits
147	**ACI**	Cumulative gigawatts of Activated Carbon Injection retrofits.
148	**CCS**	Cumulative gigawatts of Carbon Capture & Storage retrofits.
149	**FF**	Cumulative gigawatts of Fabric Filter retrofits.
150	**DSI**	Cumulative gigawatts of Dry Sorbent Injection retrofits
151	**C2G**	Cumulative gigawatts of coal-to-gas retrofits
152	**HRI**	Cumulative gigawatts of heat rate improvement retrofits
153		
154	**TOTAL CONTROLS IN NEEDS**	
155	**FGD**	Reflects cumulative gigatwatts of capacity that has control installed in NEEDS. Value is reflective of controls at all coal steam units
156	**SCR**	
157	**SNCR**	
158	**ACI**	

159		
160	**FUEL SUPPLY AND CONSUMPTION**	Provides Coal and Gas supply and consumption for given model run years.
161	**Coal Use by Region (million tons)**	Provides total coal use in million tons by power and non-power sector for given model run year.
162	Power Sector	Provides total coal use in million tons by power sector for given model run year.
163	Appalachia	Provides total coal use for power sector that comes from Appalachia coal region.
164	Imports	Provides total coal use for power sector that comes from Imports.
165	Interior	Provides total coal use for power sector that comes from Interior Region.
166	Waste Coal	Provides total coal use for power sector that comes from Waste Coal.
167	West	Provides total coal use for power sector that comes from the West Region.
168	Non-Power Sector	Provides total coal use in million tons for the non-power sector.
169	Appalachia	Provides total coal use for non-power sector that comes for Appalachia region.
170	Interior	Provides total coal use for non-power sector that comes from Interior Region.
171	West	Provides total coal use for non-power sector that comes from West Region.
172	**Power Sector Coal Use by Rank (TBtu)**	Provides total coal supply to power sector in trillion Btus (Tbtu).
173	Bituminous	Provides total bituminous coal use for power sector in trillion Btus (Tbtu).
174	Subbituminous	Provides total subbituminous coal use for power sector in trillion Btus (Tbtu).
175	Lignite	Provides total lignite coal use for power sector in trillion Btus (Tbtu).
176		
177	**Natural Gas Use (Trillion cubic feet)**	Total natural gas use by power and non-power sectors in trillion cubic feet (Tcf).

Appendix 2-1: Summary of legal and regulatory requirements considered in the IPM v.5.13 Base Case.

See Appendices 3-2, 3-3, 3-4, and 3-5 of the Documentation for EPA Base Case v.5.13 Using the Integrated Planning Model for more details on settlements and state rules.

NSR Settlements	State Settlements	Citizen Suits	State Rules	Regional/National Programs	International
Alabama Power	AES	SWEPCO	Alabama	Title IV Acid Rain Program	Canada
Minnkota Power	Niagara Mohawk Power	Allegheny Energy	Arizona	Regional Green House Gas Initiative (RGGI)	Alberta
SIGECO	Public Service Co of New Mexico	Wisconsin Public Service Corp.	California	Pacific Northwest	Manitoba
PSEG Fossil	Public Service Co of Colorado	University of Wisconsin	Colorado	NO_X SIP Call	Ontario
TECO	TVA	Tucson Electric Power	Connecticut	Western Regional Air Partnership (WRAP)	Quebec
WEPCO	Rochester Gas & Electric	Kansas City Board of Public Utilities	Delaware	Clean Air Interstate Rule (CAIR)	New Brunswick
VEPCO	Mirant-New York	Dominion Energy	Georgia	Mercury and Air Toxics Standard (MATS)	Nova Scotia
Santee Cooper	RC Cape May Holdings, LLC	Duke Energy	Illinois	Best Available Retrofit Technology (BART)	PEI
Ohio Edison			Kansas		Labrador & Newfoundland
Mirant			Louisiana		Saskatchewan
Illinois Power			Maine		
Kentucky Utilities Company			Maryland		
Salt River Project			Massachusetts		
American Electric Power (AEP)			Michigan		
Eastern Kentucky Power Cooperative			Minnesota		
Nevada Power			Missouri		
Dayton Power and Light			Montana		
Westar Energy			New Hampshire		
Duke Energy			New Jersey		
American Municipal Power			New York		

Hoosier Energy Rural Electric Coop			North Carolina		
Northern Indiana Public Service Co.			Oregon		
Tennessee Valley Authority			Pennsylvania		
Wisconsin Public Service			Texas		
Dairyland Power Cooperative			Utah		
Louisiana Generating LLC			Washington		
Dominion Energy, Inc.			West Virginia		
Wisconsin Power and Light			Wisconsin		

Appendix 3-1: Explanation of Model Plant Nomenclature

The field headers given in each row of Tables 10-14 represent model plant types. The model plant types are differentiated by fuel used (e.g., coal, oil/gas, nuclear, hydro), combustion technology (e.g., turbine, combined cycle gas), control technology (e.g., scrubber, post-combustion NO_X control), online status (e.g., new, existing, or retiring) and retrofit structure (e.g., coal plant with existing SNCR retrofit with ACI). It is helpful in understanding the nomenclature of model plants to recognize the significance of the "ret.", "exist" and "&" usage in the title. "Ret." suggests that the model plant is receiving a retrofit in or by the given run year. If there is no "exist" label that immediately follows the "ret." designation, then every control listed is a retrofit on a unit without any previously existing emission controls. The indicated are endogenous to the model.

If there is an "exist" that follows "ret." then each control listed after the "exist" and before the first ampersand (&) is an existing control and everything after the "&" is a retrofit that is added to that model plant by the model run year given. To illustrate the difference, let's look at plant types with the same controls shown but with the word "Exist" absent and when the word "Exist" is present, there will be variants in the placement of the first ampersand (&):

Sample Plant Types and Descriptions

Plant Type	Description
ExistSCR_WFGD_ACI	Existing Coal Steam with SCR, ACI and Wet FGD
Ret.ACI & SCR & WetFGD	Retrofit ACI, SCR, and Wet FGD on Existing Coal Steam
Ret.ExistACI & SCR & WetFGD	Retrofit SCR, and Wet FGD on Existing Coal Steam with ACI
Ret.ExistSCR_ACI & WetFGD	Retrofit Wet FGD on Existing Coal Steam with SCR and ACI
Ret.ExistWetFGD & ACI & SCR	Retrofit ACI, and SCR on Existing Coal Steam with Wet FGD
Ret.ExistWetFGD_ACI & SCR	Retrofit SCR on Existing Coal Steam with ACI and Wet FGD
Ret.ExistWetFGD_SCR & ACI	Retrofit ACI on Existing Coal Steam with SCR and Wet FGD

Appendix 3-2: Abbreviations Appearing in Model Plant Naming

Abbreviation	Definition
IGCC	Integrated Gasification Combined Cycle
PV	Photovoltaic
ACI	Activated Carbon Injection
FGD	Flue gas desulfurization
SCR	Selective Catalytic Reduction
SNCR	Selective Non Catalytic Reduction
CC	Combined Cycle
CT	Combustion Turbine
CCS	Carbon Capture & Storage
Ret	Retrofit
Exist	Existing