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ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS

GHG Emission Reductions From Existing Power Plants Under Section 111(d) of the Clean Air Act:
Options to Ensure Electric System Reliability

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Analysis Group

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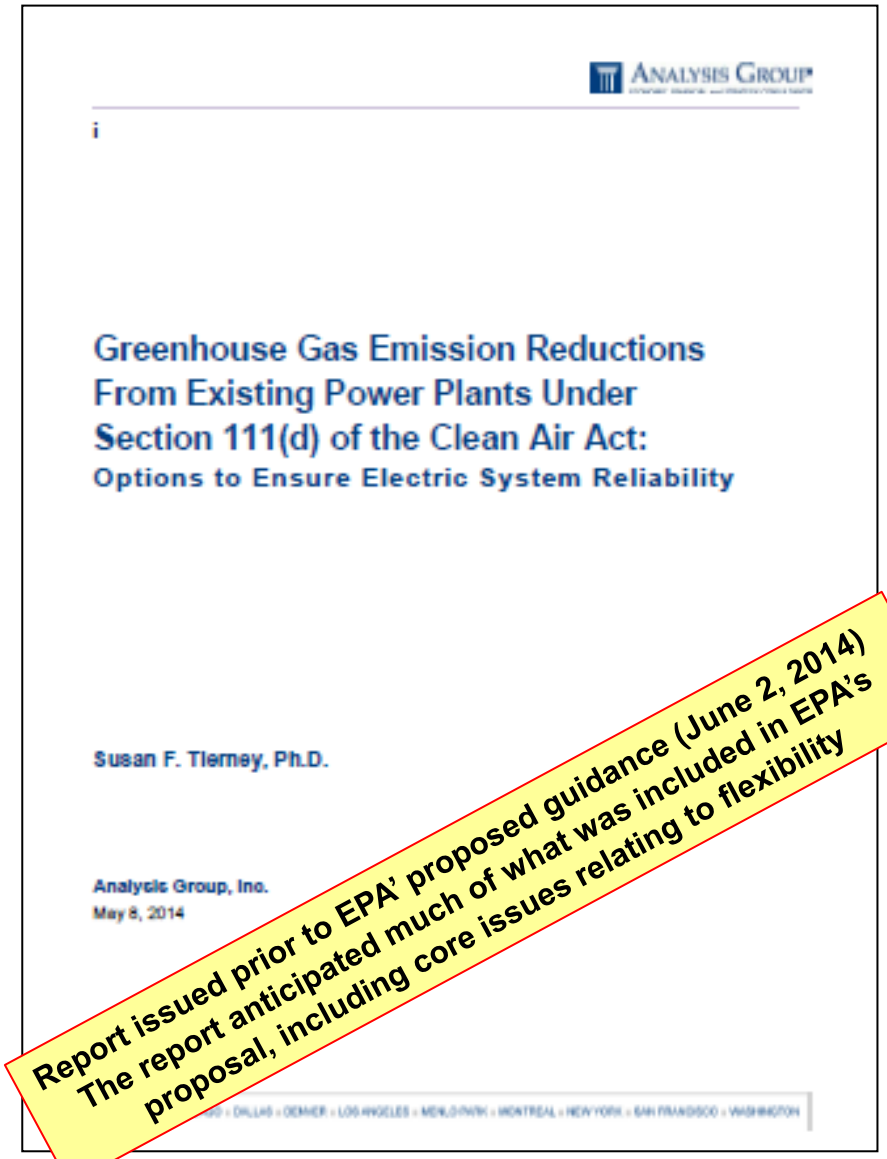
May 8 2014 Report

Key question in the report:

- **Will the nation and/or the states experience electric system reliability problems in complying with Section 111(d) and its requirements that existing fossil-fuel power plants reduce their GHG emissions?**

http://www.analysisgroup.com/article.aspx?id=14915

- The report
- A Q/A fact sheet
- A press release



Bottom line:

- There is no reasonable basis to anticipate that EPA's guidance, the states' SIPs and the electric industry's compliance with them will create reliability problems for the power system, as long as EPA and the states plan appropriately and take timely actions to assure electric-system reliability in their plans.
- Section 111(d) affords states considerable latitude to mitigate and otherwise resolve reliability concerns.

- Electric reliability (per se) is not mentioned in the CAA but is still important for the nation to assure that 111(d) and the SIPs will not jeopardize electric system reliability.
- This paper addresses whether EPA's actions to regulate GHG emissions from existing power plants will give rise to electric system reliability problems, and explains why it will not.

The context for my May 2014 report:

- June 2014: EPA's proposed guidance to the states for reducing GHG emissions from existing fossil-fuel power plants.
- June 2015: EPA's guidance is expected a year later
- 2016: States prepare and submit their SIPs – to explain how the state would prefer to achieve such emissions reductions at the power plants in its state and demonstrate why its plan complies with guidance.
- End of 2016/early 2017 (?): EPA approval of SIPs
- 2018-2020?: Compliance period begins

- My assumptions in the paper (regarding schedule for compliance) were conservative relative to EPA's proposed guidance – which sets the first compliance period in 2020-2029 (with averaging during that period) and a second compliance milestone on 2030. I had assumed there would be a sooner and shorter compliance period (starting between 2017-2020).

Electric system reliability:

- "The degree to which the performance of the elements of the electrical system results in power being delivered to consumers within accepted standards and in the amount desired. Reliability encompasses two concepts, adequacy and security. Adequacy implies that there are sufficient generation and transmission resources installed and available to meet projected electrical demand plus reserves for contingencies. Security implies that the system will remain intact operationally (i.e., will have sufficient available operating capacity) even after outages or other equipment failure. The degree of reliability may be measured by the frequency, duration, and magnitude of adverse effects on consumer service."

- Note: reliability issues (and challenges) will change in the future, with the transition to a system with greater intermittency, more reliance on fuels that need to be delivered in real-time, and more generation on customers' premises.
- My paper does not specifically address these issues relating to the need for the system to have/operate more than plain vanilla MW and MWh. These issues will be facing the industry even in the absence of this new carbon-pollution policy. That said, such issues are critically important for the industry and its regulators going forward.

The context:
Past debates about EPA rules and electric reliability

- The 2010-2012 public debates about CSAPR and MATS raised concerns about potential electric system reliability impacts from major new EPA regulations affecting power plants.
- Historically, the reliability red flag has tended to be raised with regard to concerns that compliance with a new environmental rule would require:
  - **A large portion of generating capacity to be simultaneously out of service to add control equipment, or**
  - **Permanent retirement to retire permanently, or**
  - **Otherwise to become unavailable to produce power.**
- To date, implementation of new environmental rules has not produced reliability problems, in large part because the mission-oriented industry has proven itself capable of responding effectively.

If reliability isn't in the CAA, will the EPA consider reliability impacts in this process?

- Pre issuance of EPA's Clean Power Plan: statements from federal officials that indicate that the EPA's regulations will be prepared in a way so as not to undermine system reliability
  - **Presidential Memorandum and related Executive Orders**
  - **EPA Administrator McCarthy's statements**
  - **EPA Acting Air Administrator McCabe's statements**

Many power plants will be directly subject to 111(d)

Table 2

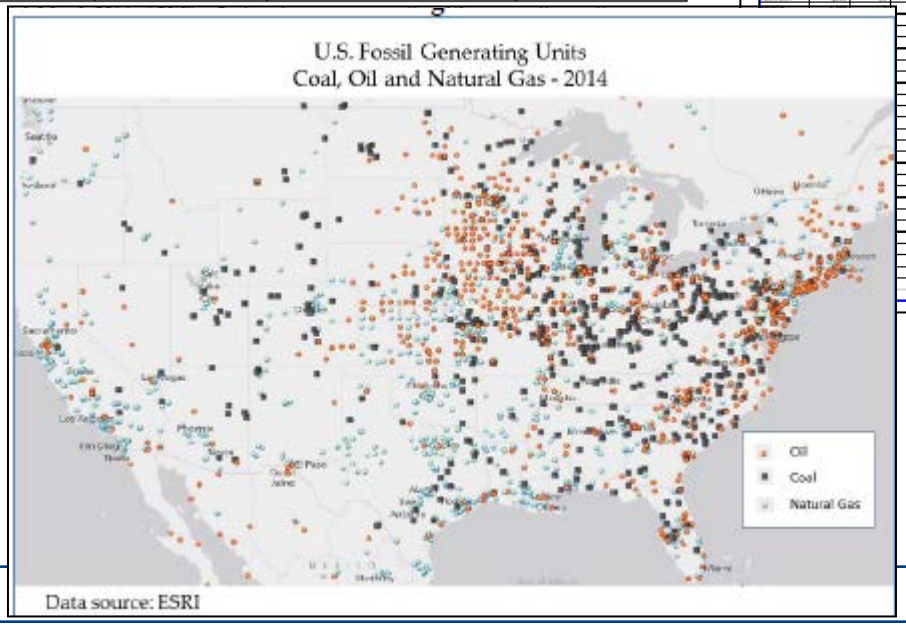
Existing Power Generation Capacity in the U.S. as of 3-2014:
All Power Plants and Power Plants Likely to be Subject to Clean Air Act 111(d)

	Generating Units Likely to Be Directly Covered by Section 111(d)* (# Units)	(GW of Capacity)	Total Grid-Connected Generating Capacity in the U.S. (GW)	111(d) Capacity as a Share of Total Capacity (%)
Coal	1204	292.4	303.7	96%
Natural Gas	1,636	216.6	414.3	52%
Oil	244	23.7	38.2	61%
Nuclear	0	0	98.0	0
Hydro	0	0	99.0	0
Wind and Solar	0	0	68.9	0
Other**	0	0	21.7	0
Total	3,804	532.4	1042.4	51%

APPENDIX 2 –

Generating Capacity Subject to 111(d) by State as of the beginning of 2013 (Page 1)

State	Steam Turbine - Coal: MW Capacity	Number of Units	Capacity Factor (2012)	Steam Turbine - Oil: MW Capacity	Number of Units	Capacity Factor (2012)	Steam Turbine - Natural Gas: MW Capacity	Number of Units	Capacity Factor (2012)	Combined Cycle - Natural Gas: MW Capacity	Number of Units	Capacity Factor (2012)	Combined Cycle - Oil: MW Capacity	Number of Units	Capacity Factor (2012)
ALABAMA	10,750	33	49%	453	15	49%	64	9	77%	6,255	42	63%	0	0	0%
ALASKA	118	18	67%	-	-	0%	-	-	0%	279	4	70%	47	1	72%
ARIZONA	6,230	18	75%	-	-	0%	974	9	7%	6,482	43	32%	0	0	0%
ARKANSAS	5,144	7	63%	300	11	71%	1,203	8	8%	3,060	23	38%	0	0	0%
CALIFORNIA	250	8	61%	-	-	0%	12,848	48	8%	12,830	129	51%	0	0	0%
COLORADO	5,377	26	73%	-	-	0%	120	4	1%	1,643	28	39%	0	0	0%
CONNECTICUT	388	1	3%	1,861	7	2%	44	5	23%	2,303	15	23%	0	0	0%
DELAWARE	430	3	31%	-	-	0%	846	6	15%	1,236	6	53%	0	0	0%
FLORIDA	10,493	29	49%	5,495	23	17%	1,038	14	22%	16,785	104	60%	0	0	0%
GEORGIA	12,583	43	38%	655	20	52%	129	2	9%	4,877	26	55%	0	0	0%
HAWAII	180	1	95%	1,119	21	46%	-	-	0%	-	-	0%	375	12	55%
IDAHO	17	8	61%	74	4	65%	-	-	0%	374	4	39%	0	0	0%
ILLINOIS	15,943	71	56%	-	-	0%	40	7	3%	2,005	14	33%	0	0	0%
INDIANA	18,283	78	58%	158	4	0%	-	-	0%	1,549	12	64%	0	0	0%
IOWA	6,784	49	60%	-	-	0%	65	2	14%	813	7	12%	0	0	0%
KANSAS	5,096	14	63%	-	-	0%	1,714	29	11%	-	-	0%	0	0	0%
KENTUCKY	15,329	54	63%	-	-	0%	-	-	0%	-	-	0%	0	0	0%
LOUISIANA	4,430	14	64%	266	7	62%	8,040	64	22%	5,916	43	54%	0	0	0%
MAINE	-	-	0%	1,222	19	20%	93	2	65%	880	5	33%	0	0	0%
MARYLAND	4,771	16	40%	1,730	4	18%	321	8	6%	157	2	31%	0	0	0%
MASSACHUSETTS	1,439	8	18%	2,138	6	1%	645	16	6%	4,315	26	34%	282	4	4%
MICHIGAN	11,778	83	53%	51	2	86%	2,182	9	4%	3,378	33	45%	0	0	0%
MINNESOTA	4,753	41	55%	15	1	50%	174	17	18%	1,502	11	29%	0	0	0%
MISSISSIPPI	2,546	7	33%	235	8	59%	2,773	23	20%	4,685	29	49%	0	0	0%
MISSOURI	12,435	51	67%	-	-	0%	116	6	1%	1,425	11	19%	0	0	0%
MONTANA	1,763	8	62%	-	-	0%	-	-	0%	41	1	0%	0	0	0%
NEBRASKA	4,160	20	69%	-	-	0%	268	9	2%	296	5	11%	0	0	0%
			36%	-	-	0%	470	5	7%	3,377	34	54%	0	0	0%
			26%	407	4	2%	-	-	0%	882	4	57%	0	0	0%
			15%	163	3	2%	629	8	3%	4,133	41	49%	0	0	0%
			72%	-	-	0%	779	11	32%	925	8	48%	0	0	0%
			25%	2,795	9	10%	6,927	22	17%	6,425	63	49%	0	0	0%
			50%	163	7	66%	-	-	0%	2,809	21	46%	0	0	0%
			78%	-	-	0%	-	-	0%	-	-	0%	0	0	0%
			49%	45	3	82%	35	2	1%	2,293	20	67%	0	0	0%
			63%	58	1	85%	5,085	32	19%	4,204	31	49%	0	0	0%
			52%	59	2	41%	32	2	28%	2,100	18	44%	0	0	0%
			58%	842	5	7%	1,635	4	11%	5,614	42	64%	0	0	0%
			0%	4	2	19%	9	4	22%	1,293	11	47%	0	0	0%
			50%	244	7	44%	107	3	47%	1,680	10	48%	0	0	0%
			68%	-	-	0%	-	-	1%	193	1	0%	0	0	0%
			52%	186	6	46%	-	-	0%	960	5	48%	0	0	0%
			69%	161	6	77%	18,553	88	13%	27,324	207	50%	0	0	0%
			72%	-	-	0%	240	4	6%	713	5	55%	0	0	0%
			0%	3	3	26%	-	-	0%	-	-	0%	0	0	0%
			26%	1,899	14	11%	334	4	7%	2,779	20	78%	0	0	0%
			32%	150	9	55%	5	1	15%	2,225	21	23%	0	0	0%
			56%	-	-	0%	-	-	0%	-	-	0%	0	0	0%
			44%	135	8	55%	7	1	16%	1,724	12	44%	0	0	0%
			77%	0	1	51%	3	3	66%	-	-	0%	0	0	0%
				22,636	227		68,489	482		148,160	1,154		705	17	



Will EPA 111(d) GHG policy adversely impact reliability?

The most important reason why raising the 'reliability' red flag is misplaced with regard to the upcoming regulations of GHG from existing fossil plants:

- **Section 111(d)'s regulatory framework creates an entirely different and potentially much wider set of compliance and implementation options compared to other recent federal regulatory initiatives applicable to the electric industry.**
- **Section 111(d)'s 'cooperative federalism' model provides for much more compliance flexibility and creativity than was possible for the many unit-specific regulations issued by EPA in the past two decades.**
- **This is core to understanding why EPA's regulation of GHG emissions from existing power plants will not jeopardize electric system reliability.**

Section 111(d) and MATS: inherently different approaches

The MATS rule:

- **EPA set uniform national standards to reduce emissions from different categories of existing coal and oil plants.**
- **No trading or averaging is allowed across different generating stations.**
- **There is no possibility of purchasing credits resulting from over-compliance at other sources, or to credit emissions reductions resulting from efficiency.**

Section 111(d):

- **Inherently allows greater opportunities for different pathways to compliance, including a wide variety of actions that a state can tailor through its SIP**
- **EPA's guidance will not likely impose a standard that must be met solely by actions taken at each affected unit.**
- **EPA will likely to establish standards specific to each state, based on the "degree of emission limitation achievable through the application of the best system of emission reduction," which may vary across states in light of their own particular circumstances.**

Section 111(d) and MATS: inherently different approaches

Section 111(d) (continued)

- **In its SIP, each state will have flexibility to propose its own preferred actions to accomplish the targeted reductions, as long as the plan provides reductions across the facilities in the state that are at least as effective as EPA's approach.**
- **This language "supports the use of market-based mechanisms" and other alternatives in ways that are not possible under the statutory language governing MATs, which required each affected generating station to have emissions at or below the allowed emissions rates.**
- **If a state has concerns about the reliability implications of compliance with EPA guidance, the state can take that fact into account as it designs its SIP and its schedule/timetable for individual units' compliance so long as the overall emission reduction required by the guideline has a firm deadline and is achieved.**
  - **For example, a state could propose plan elements that enable early action/compliance at some Section 111(d) generating units in exchange for allowing more time for others, or that allow for deeper reductions at one unit in exchange for lighter reductions at another.**

Other factors in today's context support reliability

- States differ considerably in ways that will no doubt show up in how they approach their SIP elements:
  - **Differences: the character of the power plants located in each state, the electric industry structure, the CO_2 emissions from existing power plants, renewable energy potential, reliance on in-state versus out-of-state power resources, the outlook for demand growth, mix of public policies affecting power plants, and many other differences.**
- The report provides two sets of information to describe tools that will be available to states:
  - **Description of different states' systems/policies – with suggestions for things that other states could adopt**
  - **Description of how different states with different industry structures could shape their plans to fit diverse objectives in the state.**

SIPs: options for design of element

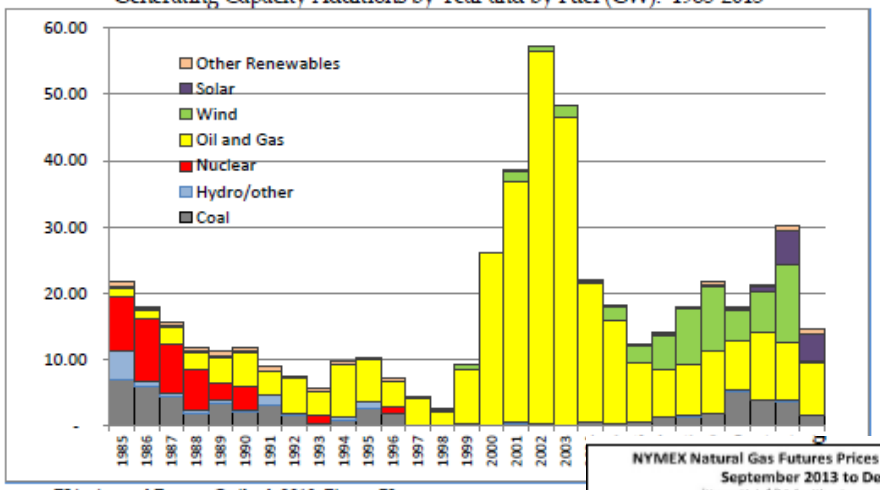
SIPS: States may consider diverse options as they plan for cost-effective emissions reductions while also ensuring electric system reliability.

- **Some of the options may take place "inside the fence" of generating units covered by Section 111(d).**
  - **Examples include: heat-rate improvements; fuel switching; averaging of emissions within a single station; and changes to the operating permit of existing power plants to limit emissions over some averaging period.**
- **Others may take place "outside the fence"**
  - **Examples include: emission reductions achieved through changes in the overall dispatch of existing generating resources and/or level of demand on the system: emission-averaging among multiple power plants; state carbon budgets with an emissions cap-and-trade program; multi-state electric-system dispatch practices of grid operators; demand-side reductions; adoption of clean energy standards; and/or transmission upgrades to open up access to underutilized, low-carbon facilities.**

Some current conditions support reliability

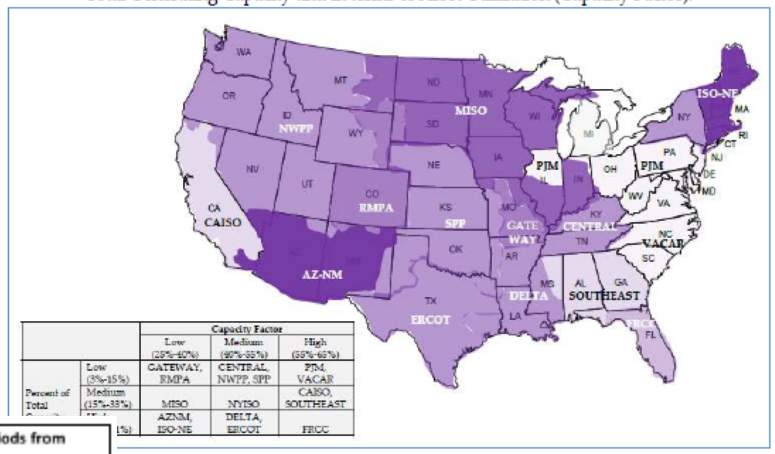
- Conditions in the industry allow for cost-effective emissions reductions at Section 111(d) units in ways that do not adversely affect system reliability.
  - **One of the most important: Underutilized existing generating capacity provide the potential for changes in dispatch at relatively low cost**

Generating Capacity Additions by Year and by Fuel (GW): 1985-2013



Source: EIA, Annual Energy Outlook 2013, Figure 78.

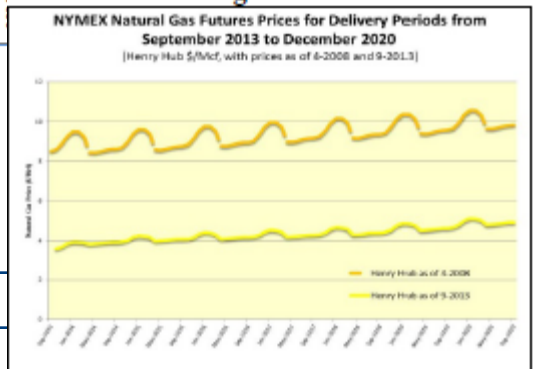
Regional Reliance on Natural Gas-Fired Combined Cycle in 2012 as a Percentage of Total Generating Capacity and in terms of Asset Utilization (Capacity Factor):



		Capacity Factor		
		Low (25%-40%)	Medium (40%-55%)	High (55%-70%)
Percent of Total	Low (3%-15%)	GATEWAY, RMPA	CENTRAL, NWPP, SPP	PJM, VACAR
	Medium (15%-35%)	MISO	NYISO	CAISO, SOUTHEAST
		AZNM, ISO-NE	DELTA, ERCOT	FRCC

NYMEX Natural Gas Futures Prices for Delivery Periods from September 2013 to December 2020

(Henry Hub $/Mcf, with prices as of 6-2008 and 9-2013)

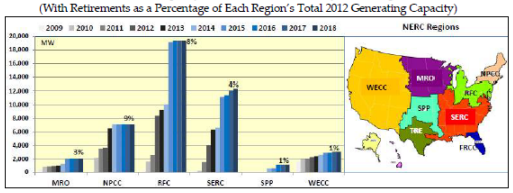


Other factors in today's context support reliability

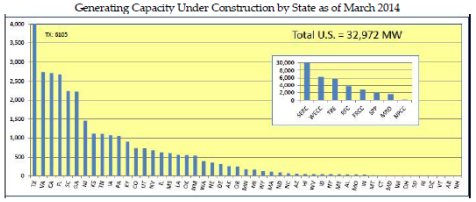
- Other factors also allow for cost-effective emissions reductions at Section 111(d) units in ways that do not adversely affect reliability.

- **States and regions are already addressing near-term resource adequacy issues (especially in the 2014-2016 period)**
- **Potential energy efficiency opportunities in all states will help reduce the need to dispatch plants with relatively high emission rates and replace retiring capacity**
- **Additional low or zero-carbon electricity supply (e.g., wind and solar; combined heat and power; nuclear uprates) is in (or could be in) the pipeline.**

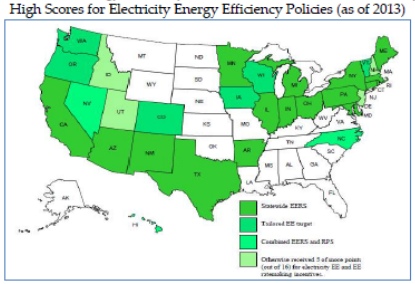
Generating Capacity Associated Actual Coal-Plant Retirements (2009-2013) and Planned Coal Capacity Retirements (2014-2018) by NERC Region (With Retirements as a Percentage of Each Region's Total 2012 Generating Capacity)



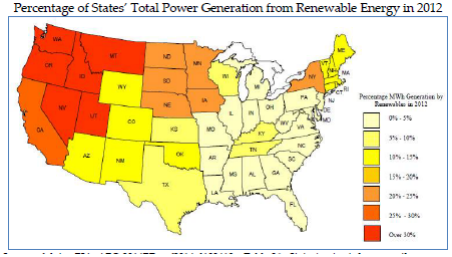
Generating Capacity Under Construction by State as of March 2014



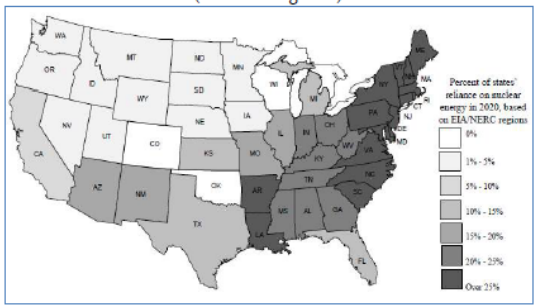
States with a Energy Efficiency Resource Standard or With Relatively High Scores for Electricity Energy Efficiency Policies (as of 2013)



Percentage of States' Total Power Generation from Renewable Energy in 2012

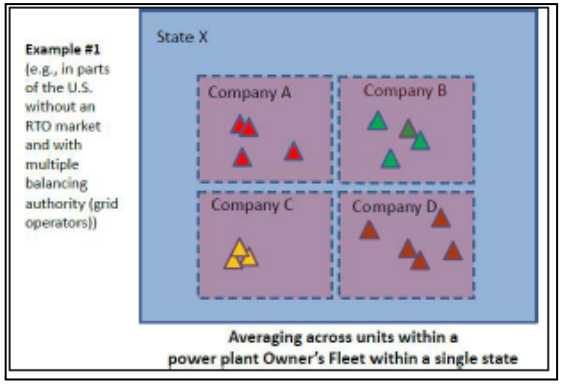


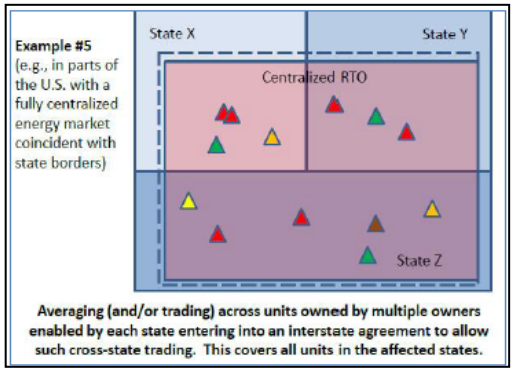
Projected Regional Reliance on Nuclear Energy 2020 (NERC Subregions[80])

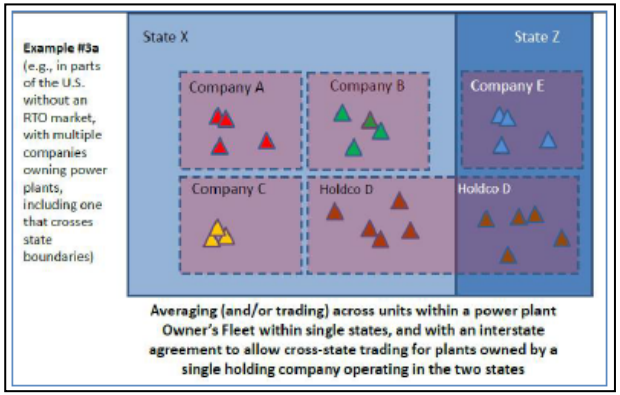


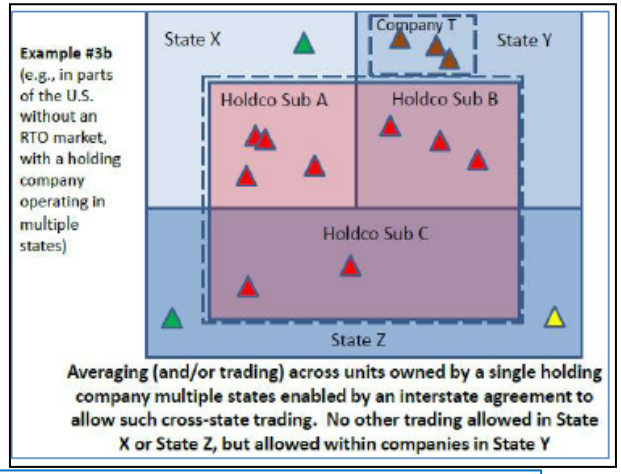
Examples of ways to design compliance strategies in different industry contexts

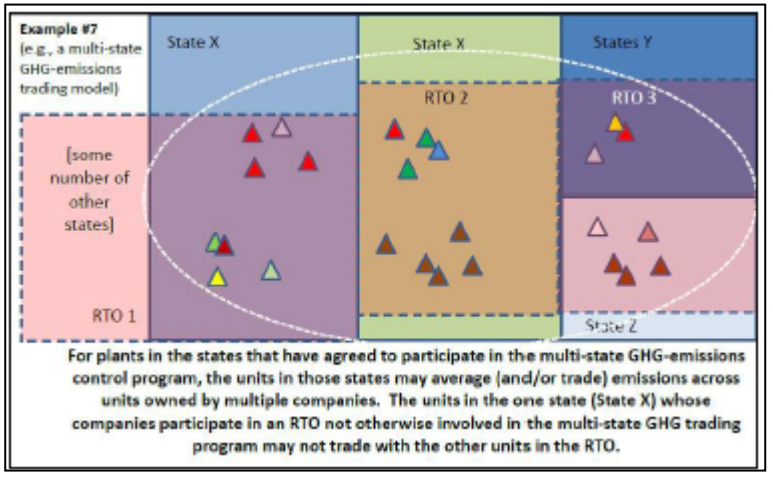
- The paper illustrates possible ways that states could consider shaping their SIPs to suit their own conditions.











EPA's proposed Clean Power Plan

Other implications of the proposal for making sure that system reliability issues become part of the planning process?

- **Use the upcoming planning processes to examine not only MW (resource adequacy) and MWh (energy impacts), but also other attributes needed for an electric system with different performance challenges:**
  - **On-site fuel availability**
  - **Ramping capacity**
- **Examine the implications of further wholesale energy price formation in energy and capacity markets of a system with mainly natural gas on the margin, more capital intensive resources (e.g., renewables, transmission assets) with low variable costs, on the sufficiency of incentives for entry of new resources**

Bottom line:

- There is no reasonable basis to anticipate that EPA's guidance, the states' SIPs and the electric industry's compliance with them will create reliability problems for the power system, as long as EPA and the states plan appropriately and take timely actions to assure electric-system reliability in their plans.
- Section 111(d) affords states considerable latitude to mitigate and otherwise resolve reliability concerns. And they will have time to put in place actions to assure reliable electricity supply as part of their tailored SIP.

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