ANALYSIS GROUP
ECONOMIC, FINANCIAL and STRATEGY CONSULTANTS
Main 1 617 425 8000 Fax 1 617 425 8001 www.analysisgroup.com
111 Huntington Avenue Tenth Floor Boston, MA 02199

TO: Electric Reliability Options Study Advisory Group

FROM: Paul Hibbard, Craig Aubuchon
Analysis Group

RE: Study Overview
Meeting 1 of the Study Advisory Group
August 19, 2015

DATE: 14 August 2015

Overview

This Memo provides an overview of the Attorney General's Office (AGO) Regional Electric Reliability Options Study (Study), to be conducted by Analysis Group (AG). The purpose of the overview is to introduce at a high level the goals of the study and the analytic approach. In the meeting we will provide more detail on the items outlined in this memo, and seek feedback from the members of the Study Advisory Group (SAG).

The AGO has asked Analysis Group to provide an independent analysis of potential electric system challenges through 2030, with particular attention to the availability of resources to meet winter system needs. The Study will focus on the New England region as a whole, estimate potential electric system needs, and identify and evaluate resource combinations that could address any identified deficiency. Each potential solution set will be analyzed and compared with respect to costs and GHG emission impacts.

It is our expectation and hope that the Study Advisory Group members will be able to provide helpful perspectives and information on resource and cost inputs to the analysis, and on modeling process and results. However, we want to emphasize that Analysis Group's review will be independent and objective – AG ultimately will be solely responsible for the data, analysis, assumptions, and judgments that go into completing the Study. SAG members will not be responsible for Analysis Group's method, findings or observations, or be expected to endorse any aspect of the Study.

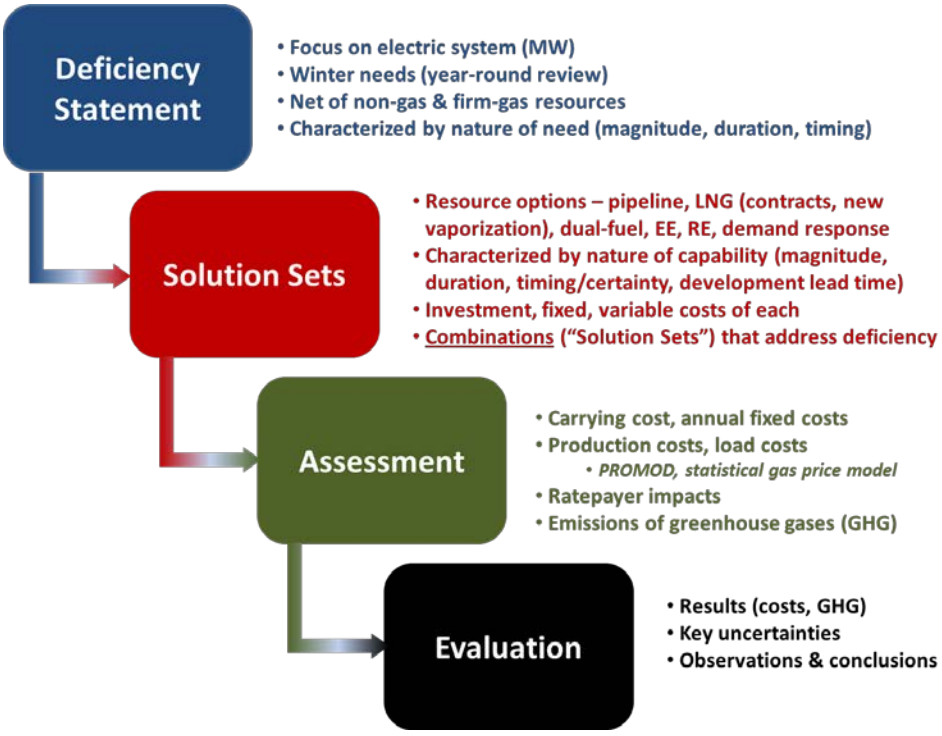
We appreciate your willingness to participate, and look forward to working with the Attorney General's Office, Raab Associates, and the members of the SAG on this timely and important study.

Analytic Method

New England generating capacity additions and operations are governed by the administration of competitive wholesale markets for capacity, energy, and ancillary services. Recent changes to those markets are expected to provide incentives to ensure that generation capacity is available to

meet system needs every hour of the year.[1] Nevertheless, the wholesale market construct has two features that have been the focus of significant analysis and policy deliberation in recent years: (1) resource attrition (i.e., from nuclear, coal, and oil-fired capacity) and addition of gas-fired capacity are increasing the region's reliance on power plants using natural gas as the primary fuel, and (2) to date, natural gas power plant owners have for the most part not found it in their financial interest to purchase firm natural gas transportation capacity for power plant operations. In light of these two features of wholesale market operations, there is concern that under some scenarios the region could have insufficient generating and demand resource capacity available to meet electric system needs, and/or that system constraints lead to high prices, particularly under cold winter conditions with periods of high natural gas demand from all sectors (especially for home heating demand).

The focus of this analysis is on these potential electric system deficiencies in the New England region between now and 2030, and how the system may evolve while maintaining system reliability. Specifically, our starting point will be to identify the timing, magnitude, and nature of deficiencies that would exist on the electric system absent new resource development. This evaluation will take into consideration electric system load and all available resources, with attention to the amount of natural gas transportation likely to be available for electricity generation. We will then evaluate a discrete set of solution sets that represents various plausible combinations of infrastructure and/or resource options in amounts that (1) are sufficient to address the deficiency, (2) can result from the operation of market outcomes (or otherwise be implemented through regulatory action), and (3) can attain a trajectory of GHG emissions that will not preclude the region meeting its long-term GHG reduction commitments.



[1] Recent market changes include, among others, capacity market performance incentives, the timing and structure of energy market offers, changes to levels procured and pricing in reserve markets, and clarification of the responsibilities of generators with capacity supply obligations.

The following discussion summarizes at a high level the basic elements of the analytic approach, and metrics for evaluation of potential solution sets.

Deficiency Statement: The first step in the analysis will be an evaluation of the potential deficiencies on the electric system over the forecast horizon, in consideration of electric demand and resources, and potential availability of natural gas for electricity generation. Our assumption is that reliability will be maintained; the purpose of the deficiency analysis is to identify the potential magnitude of resource and infrastructure needs to maintain reliability.[2] Elements of the deficiency analysis/statement include:

- A forecast of regional electricity demand over the forecast period.
- "Firm" generation and demand resource capabilities over the forecast period, including all existing resources, known additions and retirements, and renewable resources needed to meet states' renewable portfolio standards. The representation of existing resource capabilities will separate out natural gas-only resources that do not have firm commitments, arrangements for delivered fuel, or secondary fuel supplies.
- A representation of existing natural gas available for electricity generation based on an analysis of transportation capacity and known LNG supply, net of natural gas local distribution company (LDC) demand. The estimated availability of natural gas will be translated into electric generating capacity availability based on a gas-fired generation supply curve (excluding dual fuel units) for the region. This capability will be added to the non-gas resource capability values to estimate total available electric generation capability.
- The electricity demand forecast and the total available electric generating capability will be combined to identify potential electric system deficiencies over the forecast period; the deficiency analysis will be characterized by the nature of the deficiency (e.g., magnitude, duration, frequency) to inform the identification of solution sets for evaluation.

Solution Sets: The next step in the analysis will be the identification of a discrete set of resource/infrastructure combinations that may result from the operation of market outcomes (or otherwise be implemented through regulatory action), and that are sufficient to maintain reliability. Any resource combinations that can not plausibly address the identified deficiency and maintain reliability will not be evaluated as a solution set. Elements of the solution set identification include:

- Identification of resource alternatives, including incremental natural gas capacity deliverable to electric generators during times of deficiency (dedicated pipeline delivery capacity, LNG contractual supply, or satellite LNG storage/vaporization capacity); incremental dual-fuel capability; incremental grid-connected hydro and renewable resources; incremental distributed resources (energy efficiency, renewables, demand resources, etc.).
- Identification of resource specifications, including investment costs for the resource and any ancillary infrastructure (such as incremental transmission), fixed annual costs,

[2] While we use the term "deficiency," we recognize that fundamentally power system reliability will be preserved, even if it is uncertain at this time exactly how. Our study analyzes the ratepayer cost implications of various plausible combinations of resources and infrastructure that may emerge to maintain reliability over time.

variable costs, operating specifications (e.g., heat rate, timing/duration of operations, operational certainty).

- Development of solution sets, as combinations of plausible resource alternatives that, in total, are able to address the identified deficiencies. Solution sets will be sized to match the frequency, duration, and magnitude of deficiencies, and not preclude attainment of states' long-term GHG objectives. Identified solution sets will be defined with respect to total annual carrying charge, other fixed costs, variable operating costs, effective GHG emission rate by resource, development time frames, and any relevant operating conditions or rules (e.g., when/how often a demand resource may be called).

Assessment and Evaluation: The final steps of the analysis will be to identify and compare total costs and GHG emissions of each solution set, report results, and identify relevant observations or conclusions that flow from the analysis. In the Assessment and Evaluation phase we will conduct a full economic review of all solution set costs and benefits, from ratepayer and system perspectives (that is, including a review of both the up-front investment and other fixed costs, as well as the impact of the solution set on system dispatch costs). Elements of the assessment and evaluation steps include:

- Calculation of annualized investment and fixed costs for each solution set, including any associated infrastructure (e.g., incremental transmission).
- Modeling of system impacts, identifying total production costs, revenues to generators, costs to load, and emissions of GHG. System evaluation will be completed using PROMOD, incorporating natural gas price forecasts that vary by scenario/solution set. These gas price forecasts will based on a statistical analyses of the historical relationship between natural gas demand, system utilization, and price.
- Evaluation of solution sets with respect to effectiveness in meeting reliability needs, ratepayer and production costs, GHG emissions, required market or out-of-market actions, feasibility/practicality/timing, and key uncertainties and risks.
- Development of Analysis Group observations and/or conclusions based on the analysis.

Data

AG will rely on public data to the extent feasible, and as part of our analysis we are reviewing the data provided in all recent reports and analyses on this or similar topics. We recognize that, in the end, different entities may have different viewpoints on resource capacities, load growth forecasts, resource feasibility, and cost data. While ultimately the final decision on inputs rests with AG, we plan to review with the SAG the specific data and assumptions going into the analysis in order to get feedback and alternative viewpoints and information, particularly where inputs are estimates based on relatively thin data or proprietary information. AG will specifically identify initial data sources and assumptions during the first SAG meeting, but expects to continue to vet these with SAG members beyond the first meeting.

Tentative Schedule

August 19: First SAG meeting
August 19-September 17: Data collection, model set up
September 17: Second SAG meeting
September 17-October 16: Modeling and evaluation; development of initial results; initial drafting of report
October 16: Third SAG meeting

Note: we expect to continue the dialogue with SAG members between meetings as needed and appropriate.