Use of Regional Resource Forecasts In the Midwest ISO's and the Joint Coordinated System Plan Economic Transmission Planning Process

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***Abstract*-- This paper describes the need and application of regional resource forecasts in the development of the economic transmission expansion planning.**

***Index Terms*-- Nomenclature**
Economic transmission expansion plan, regional resource forecasts, Joint Coordinated System Plan (JCSP), Midwest ISO transmission expansion plan (MTEP), wind, Eastern Interconnection.

I. INTRODUCTION

The use of a regional resource forecast model in conjunction with powerflow and security constrained economic dispatch models will be illustrated as part of the planning process required for developing economic transmission projects. The use of these models as part of an integrated process for transmission planning specifically focusing on the development of economic transmission projects is new. The process for developing economic transmission that is being used for the Midwest ISO Transmission Expansion Planning is outlined in Figure 1.

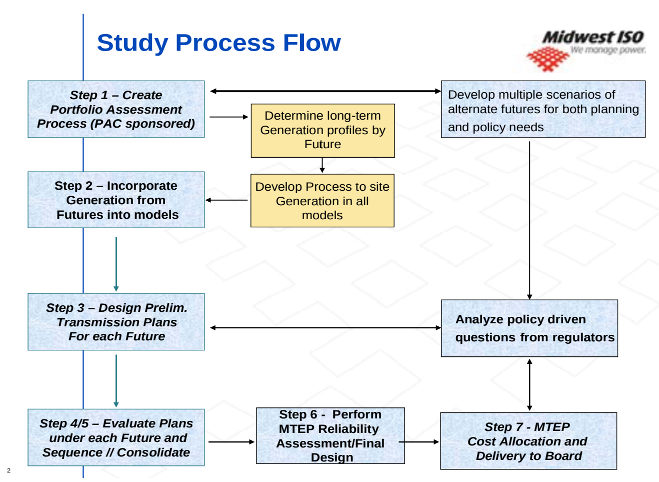


Figure 1

This process, in addition to being used for the MTEP is also being used for the Joint Coordinated System Plan (JCSP) as described below. This paper addresses Step 1 and Step 2 of the study process while Step 3 is addressed in a paper 08TD0721 by Dale Osborn titled 'Transmission Plan Development Based on Economic Studies'.

The Midwest ISO (MISO) has Joint Operating Agreements with the PJM Interconnection (PJM), Tennessee Valley Authority (TVA) and the Southwest Power Pool (SPP). These Agreements call for joint system studies to be performed at least every three years. Instead of performing multiple separate studies with a reduced scope, the four Organizations are pursuing a large Joint Coordinated System Plan (JCSP) for the 2007/2008 timeframe for the purpose of both reliability and economic assessment. Concurrently, the Department of Energy (DOE) is undertaking a study to evaluate the wind potential in the eastern United States and to perform a study on the transmission required for a 20% wind energy case and a 30% wind energy mandate for a large section of the Eastern Interconnection. This study, called the Eastern Wind Integration Transmission Study (EWITS), is being performed over the same time frame as the JCSP and covers a similar scope. Therefore, the JCSP study effort is collaborating with DOE to perform the EWITS study whereby the transmission required to meet a 20% and 30% wind energy mandate is postulated. The integrated process described in this paper conforms to the combined reliability and economic process used to develop the 2008 Midwest ISO Transmission Expansion Plan.

II. Discussion

To accomplish long range economic transmission development, a planning horizon of at least 15 years is necessary to encompass the reality that large transmission projects nominally require ten years to complete. To be able to perform a credible economic assessment over this period, several analytical challenges have to be addressed. Specifically, long-range sophisticated resource forecasting, powerflow and security constrained economic dispatch models are required to extend out at least 15 years. Since there isn't a single model that can perform all of the required functions needed for integrated transmission development, we take the best models and develop a process around the use of those models to integrate them together. The use of this integrated process enables the evaluation of the long-term transmission requirements to proceed.

To develop the required out year models we start with an 8-10 year out powerflow model developed by the Eastern Interconnection Reliability Assessment Group's Multiregional Modeling Working Group (MMWG). In order to develop the 15-20 year out model there are two important components that are required to be forecasted. The first is the demand in the out year and the second is the new generation required for meeting reserve/reliability requirements. The load forecasts are normally based on econometric forecast models and the need for these models is generally understood and accepted and is not discussed in this paper. The resource forecast is directly linked to the load forecast plus the resource adequacy requirements for a given region.

To populate the out year transmission and economic assessment models with appropriate generation resources, a forecast of the type, timing and location of these future generating resources based off of coordinated assumptions across all regions, is required. The intention here is to develop a logical combination of resources and locations that are based off of economic considerations in stead of placing arbitrary generation at locations that help solve a specific transmission constraint.

The question of do you site transmission first and then build generation; or, site likely generation and then build the transmission system to support the generation assumptions, is at the heart of the matter. The indicative siting of generation is likely to be controversial, however, the tariff driven queuing system hasn't provided the time horizons required; and, absent the generation assumption, transmission line benefits analyses have no economic under-pinning. Using the fixed in place generation developed through a regional resource forecast as a starting point allows for the development of the transmission plan to provide integrated reliability and economic enhancements. This methodology is being used for the JCSP study.

The initial scope of the JCSP study is to develop the transmission required to meet three separate scenarios: 1) A Reference case that captures existing regulatory wind mandates and represents known current conditions, 2) A 20% wind energy mandate for much of the Eastern Interconnect, and 3) A 30% wind energy mandate for much of the Eastern Interconnection. However, based on the initial analysis of the wind requirements under the 30% wind scenario, the development of a transmission plan for this scenario was eliminated.

Since the JCSP study involves the majority of the eastern interconnection, a resource forecast for that entire area is required. Resource forecasts through 2024 are developed for 10 separate regions shown in Figure 2.

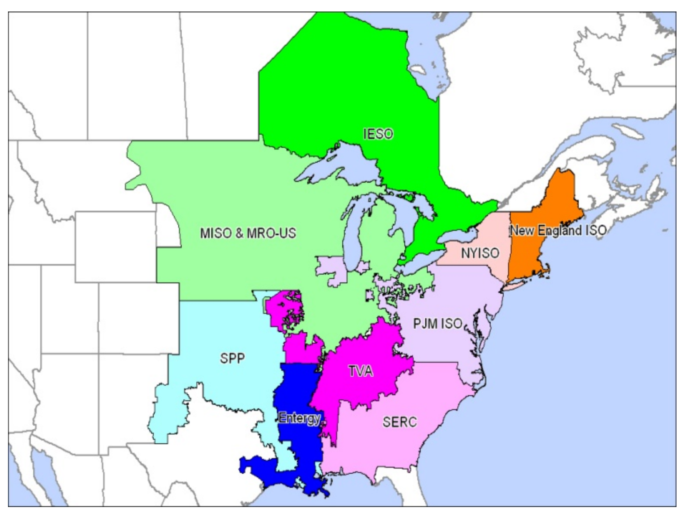


Figure 2

The regions shown in Figure 2 represent an initial demand of approximately 733,000 MW in 2008.

To develop the regional resource forecasts for each of the 10 regions and for both the Reference and

20% wind energy scenarios, the Electric Power Research Institutes Electric Generation Expansion Analysis System (EGEAS) model is used. In the Reference Case 230,000 MW is added over the 2008 to 2024 period to reach 966,000 MW in 2024.

The following two figures represent the resource forecasts by type and region through the 2024 timeframe. Figure 3 covers the MISO, PJM, TVA, SPP and Entergy regions and Figure 4 contains

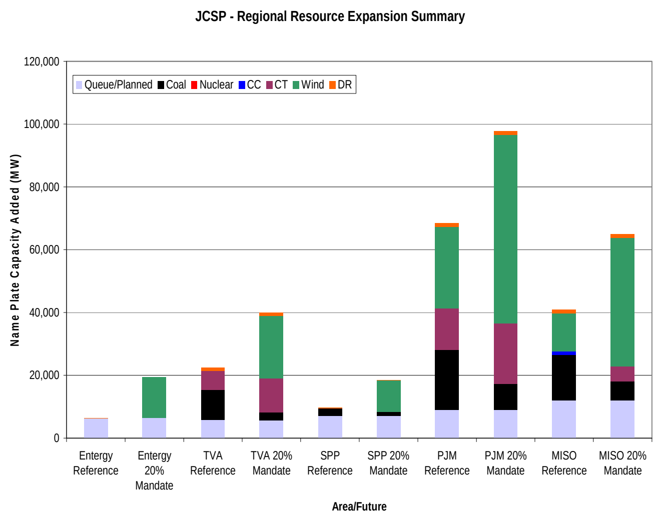


Figure 3

the remaining five regions of New York ISO (NYISO), New England ISO (NEISO), non-MISO portion of the MRO (MRO), Independent Electric System Operator (IESO) and SERC.

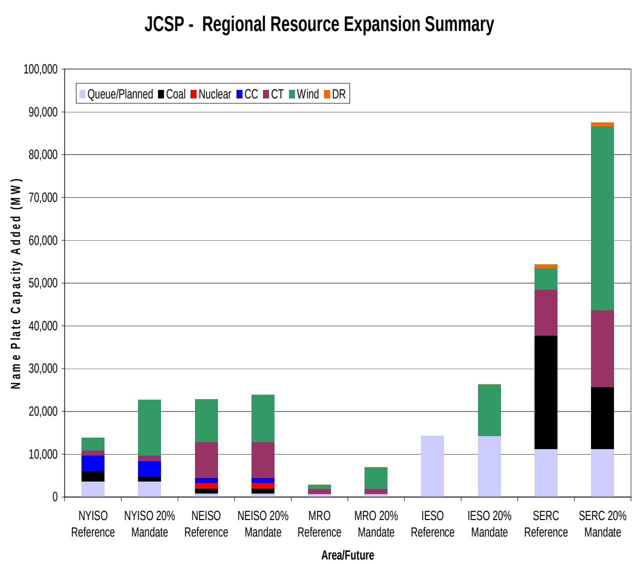


Figure 4

In the 20% wind energy scenario, 385,000 MW of new capacity is added over the 2008 through 2024 period. More capacity is added in the 20% wind energy scenario due to the amount of wind required in the resource mix. From a capacity standpoint, wind is treated as an intermittent resource and receives a 15% capacity credit; whereas a dispatchable resource would receive a 100% capacity credit for resource adequacy purposes.

The resources that are forecasted from the EGEAS model, for each of the scenarios, are specified by type and timing; but, these resources are not site specific at this point. A siting methodology to tie each resource to a specific bus in the powerflow models is required to complete the process.

A philosophy and rule based methodology in conjunction with industry expertise is used to site the forecasted generation. Figure 5 illustrates the preliminary location of all generation sited under the Reference scenario. The final siting, not completed at the time this paper, may slightly modify these results.

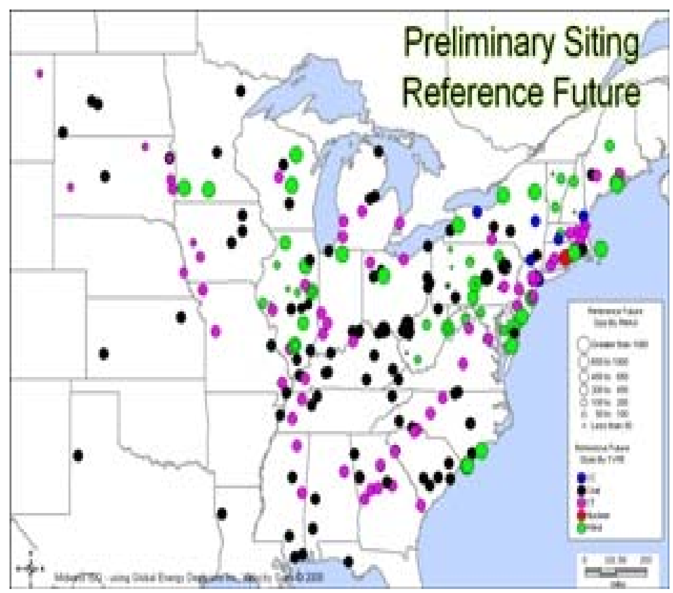


Figure 5

The general siting methodology is guided by the following philosophy:

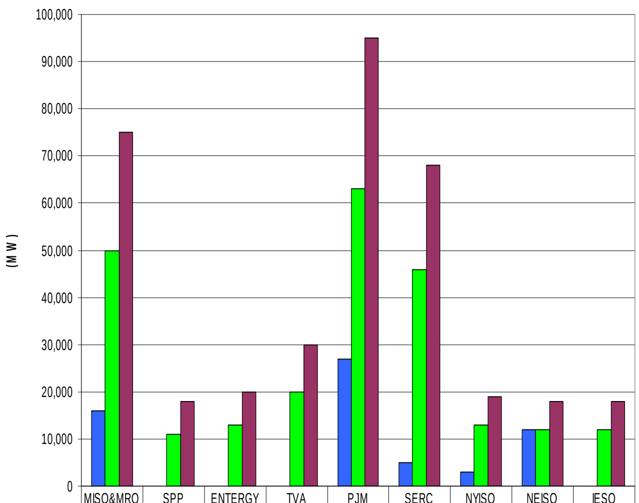
- Transmission is not a siting factor
- Site by region with the exception of wind
- Not all generation in a region can be placed in one state and one state cannot be excluded from having generation sited

- Avoid Greenfield sites for gas units if possible
- Limit the total expansion to a site to no more than an additional 2,400 MW

The rule based methodology consists of setting a priority order for site selection as follows:

- *Priority 1* - Future generation proposed and moving forward through the regulatory process (Queued generation)
- *Priority 2* – Brownfield sites
- *Priority 3* – Retired or mothballed unit sites
- *Priority 4* – Greenfield sites

The amount of wind capacity added by region for each of the scenarios is shown in Figure 6. The siting of the wind resources was performed in conjunction with DOE staff (from the National renewable Energy Lab) involved in the study.

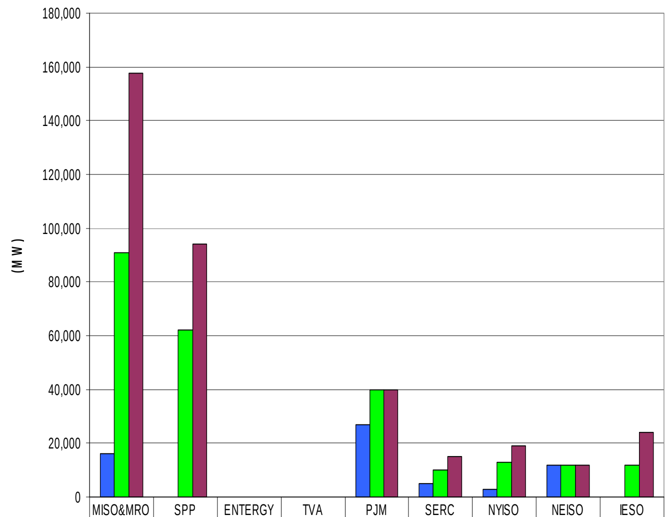


	MISO&MRO	SPP	ENTERGY	TVA	PJM	SERC	NYISO	NEISO	IESO
Reference	16,000	0	0	0	27,000	5,000	3,000	12,000	0
20%	50,000	11,000	13,000	20,000	63,000	46,000	13,000	12,000	12,000
30%	75,000	18,000	20,000	30,000	95,000	68,000	19,000	18,000	18,000

Figure 6

Under the 20% wind energy scenario several regions could not site all of their wind requirements within their region, specifically TVA, Entergy and SERC. Therefore to site all of the wind requirements a redistribution of wind location by region was required and Figure 7 shows the results of this redistribution.

As indicated in Figure 7, the Midwest ISO and SPP regions are most heavily impacted in that approximately 90,000 MW of wind would need to be shifted to these two regions.



	MISO&MRO	SPP	ENTERGY	TVA	PJM	SERC	NYISO	NEISO	IESO
Reference	16,000	0	0	0	27,000	5,000	3,000	12,000	0
20%	91,000	62,000	0	0	40,000	10,000	13,000	12,000	12,000
30%	157,667	94,000	0	0	40,000	15,000	19,000	12,000	24,000

Figure 7

With the redistribution of the regional wind requirements the siting process can be completed. Upon completion of the siting of all regional resources, the powerflow and economic assessment models can be completed with all generation assigned to a specific bus. This completes Steps 1 and 2 of the study process and allows for the transmission development phase of the study to proceed.

III. Summary

The planning of high voltage economic transmission needs to involve the largest possible system configuration possible; in the case of the eastern U.S. this effectively means the majority of the Eastern Interconnection. As models are required that cover broad geographical areas over extensive future time horizons, such as the Eastern Interconnection for the next 15-20 years, the need for regional resource forecasting to provide consistency in future resource assumptions is essential to an integrated transmission development process.

The regional resource planning model EGEAS is used to determine the resources required in conjunction with the wind energy mandates. New capacity additions including coal, nuclear, gas turbines and combined cycles, wind and demand response are all part of the future resource mix. The amount of new capacity needed by 2024 is between 230,000 MW under the Reference case and 385,000 MW for the 20% wind energy mandate case. More capacity is required for the 20% wind mandate case due to wind being treated as an intermittent resource with a 15% capacity credit for resource adequacy purposes. Use of this process led to a strategic understanding of the implications into the use and siting of wind.

Resource forecasting models have to be supplemented with siting models and a thorough philosophy and rule based siting methodology to link future resources to specific buses in the powerflow and economic assessment models. Only once the forecasted resources have been sited can the actual development of the transmission required to deliver energy over the Eastern Interconnection be undertaken.

IV. Acknowledgment

The author gratefully acknowledges the contributions of Jason Schmidt, Jameson Smith, Raja Thappetaobula and Ryan Westphal for their work in developing the regional resource forecasts and siting of resources upon which this paper is based.

V. BIOGRAGRY

John Lawhorn received a B. E. in Energy and Power Systems and M. S in Nuclear Engineering from the University of New Mexico. He is the Director of Regulatory and Economic Studies within the Transmission Asset Management group of the Midwest ISO. His primary responsibilities involve the economic assessment and development of transmission, resource assessment and regulatory studies that address the concerns of the multiple state jurisdictions that comprise the Midwest ISO.